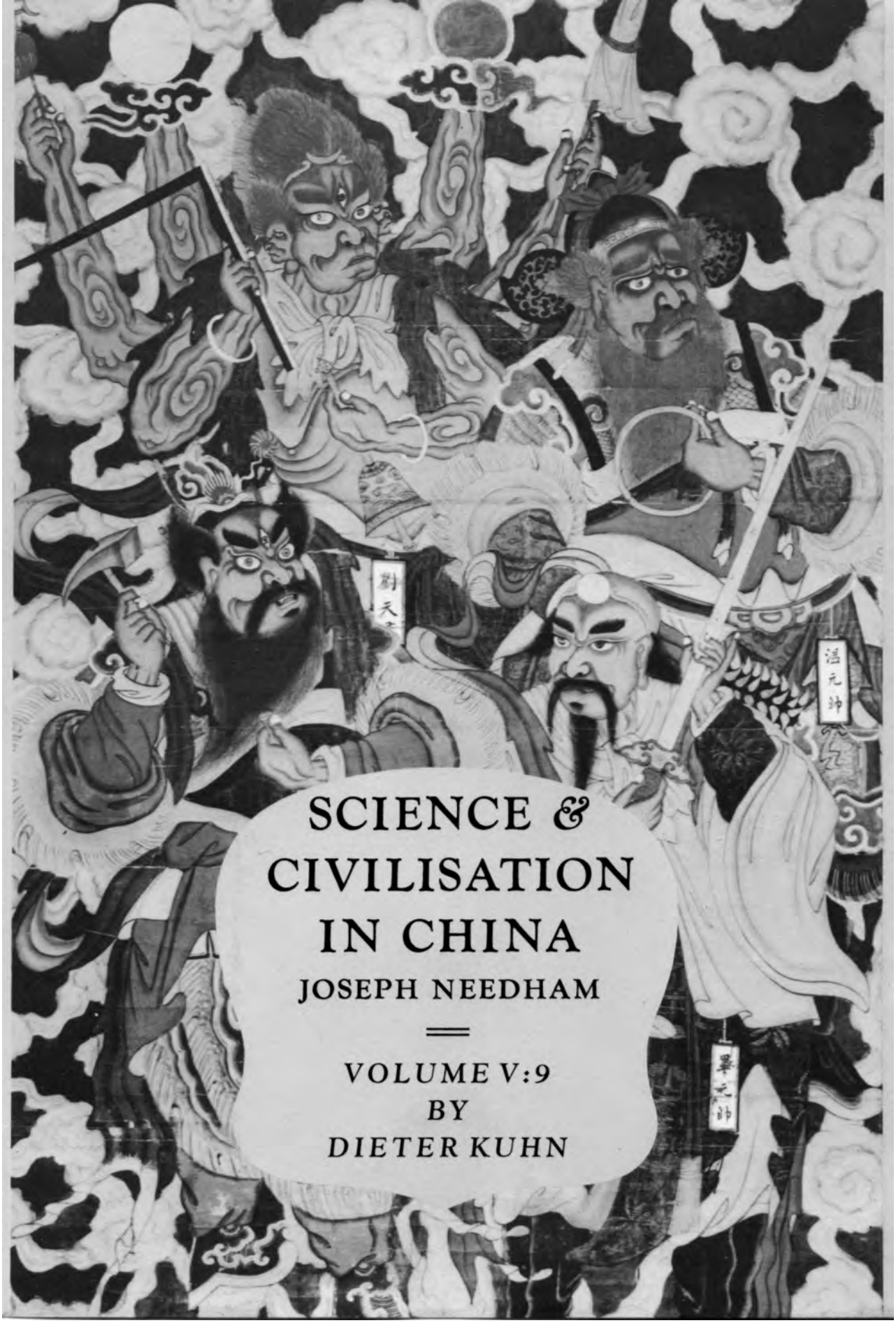


SCIENCE & CIVILISATION IN CHINA

JOSEPH NEEDHAM

VOLUME V:9
BY
DIETER KUHN

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LAURENCE PICKEN in *The Guardian* (Manchester)

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This study, the first of two parts which will give a comprehensive account of Chinese textiles and textile technology, deals with the evolution of bast-fibre spinning and silk-reeling in die history of China. These operations are the basic techniques in the production of yarn and thread, pre-requisite to weaving, and any study of Chinese textile technology must start with the raw material obtained from fibre plants such as hemp, ramie, jute, cotton etc., and silk reeled off from cocoons of the domestic silkworm.

Here for the first time in a publication outside China, the raw material, and the processing techniques applied to it, are documented in their context of historical evolution, geographical distribution and economic significance in an agrarian society. The time-span covered runs from the neolithic to the nineteenth century. Archaeological and pictorial evidence, the bulk of it hitherto unpublished in the West, is brought together with Chinese textual sources (which are extensively translated and interpreted) to illustrate Chinese achievements in this field.

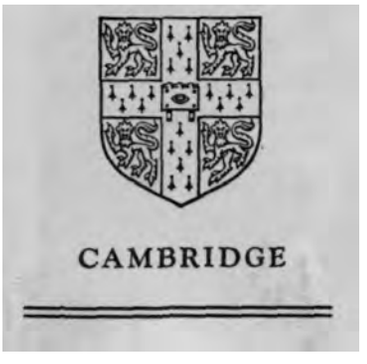
Professor Kuhn's study reveals the way in which Chinese textile-technological inventiveness has influenced textile production in other regions of the world and in medieval Europe. It explains how textile technology reached its high point between the tenth and thirteenth centuries and attempts to indicate the reasons for its subsequent relative decline. The development of the textile industry in Europe was a key factor in the rise of capitalism. In the case of China after Sung times, textile technology and the organisation of textile labour may help indicate why such a development did not take place in China.

SCIENCE AND CIVILISATION IN CHINA

VOL. V:9

JOSEPH NEEDHAM

DIETER KUHN



THE PICTURE OF THE TAOIST GENII PRINTED ON THE COVER of this book is part of a painted temple scroll, recent but traditional, given to Mr Brian Harland in Szechuan province (1946). Concerning these four divinities, of respectable rank in the Taoist bureaucracy, the following particulars have been handed down. The title of the first of the four signifies 'Heavenly Prince', that of the other three ' Mysterious Commander'.

At the top, on the left, is Liu *Thien Chiln,* Comptroller-General of Crops and Weather. Before his deification (so it was said) he was a rain-making magician and weather forecaster named Liu Chün, born in the Chin dynasty about + 340. Among his attributes may be seen the sun and moon, and a measuring-rod or carpenter's square. The two great luminaries imply the making of the calendar, so important for a primarily agricultural society, the efforts, ever renewed, to reconcile celestial periodicities. The carpenter's square is no ordinary tool, but the gnomon for measuring the lengths of the sun's solstitial shadows. The Comptroller-General also carries a bell because in ancient and medieval times there was thought to be a close connection between calendrical calculations and the arithmetical acoustics of bells and pitch-pipes.

At the top, on the right, is Wên *Yuan Shitai,* Intendant of the Spiritual Officials of the Sacred Mountain, Thai Shan. I Ie was taken to be an incarnation of one of the Hour-Presidents *(Chin Shen),* i.e. tutelary deities of the twelve cyclical characters (see Vol. 4, pt. 2, p. 440). During his earthly pilgrimage his name was Huan Tzu-Yii and he was a scholar and astronomer in the Later Han (b. +142). He is seen holding an armillary ring.

Below, on the left, is Kou *Yuan Shuai,* Assistant Secretary of State in the Ministry of Thunder. He is therefore a late emanation of a very ancient god, Lei Kung. Before he became deified he was Hsin Using, a poor woodcutter, but no doubt an incarnation of the spirit of the constellation Kou-Chhen (the Angular Arranger), part of the group of stars which we know as Ursa Minor. He is equipped with hammer and chisel.

Below, on the right, is Pi *Yuan Shuai,* Commander of the Lightning, with his flashing sword, a deity with distinct alchemical and cosmological interests. According to tradition, in his early life he was a countryman whose name was Thien Hua. Together with the colleague on his right, he controlled the Spirits of the Five Directions.

Such is the legendary folklore of common men canonised by popular acclamation. An interesting scroll, of no great artistic merit, destined to decorate a temple wall, to be looked upon by humble people, it symbolises something which this book has to say. Chinese art and literature have been so profuse, Chinese mythological imagery so fertile, that the West has often missed other aspects, perhaps more important, of Chinese civilisation. 11ère the graduated scale of Liu Chün, at first sight unexpected in this setting, reminds us of the ever-present theme of quantitative measurement in Chinese culture ; there were rain-gauges already in the Sung (+ 12th century) and sliding calipers in the Han (+ ist). The armillary ring of Huan Tzu-Yii bears witness that Naburiannu and Hipparchus, al-Naqqâsh and Tycho, had worthy counterparts in China. The tools of Hsin Hsing symbolise that great empirical tradition which informed the work of Chinese artisans and technicians all through the ages.

SCIENCE AND CIVILISATION IN CHINA

When the wheat is green and luxuriant
and the barley yellow,
Every morning at sunrise
when the air is still cool,
The girls and women exchange few words,
they have much work to do;
The odour of cocoons boiling behind the shed
comes through to the front of the gate.
The reeling-frame creaks
like rain spattering in the wind.
The cocoons are fat and their long filaments
reel unbroken threads.
How shall we find the time this year
to weave silk clothes?
Tomorrow we will goto the Western Gate
and sell the raw silk.

Shih Hu CM Shih Shih Chi,
ch. 3, p. 4a.

There are but two roads that lead to the gate of Eternal Life:
Either one bores his head in the mud like a worm,
or like a dragon flies up high into the sky.

Robert van Gulik (9), *The Chinese Maze Murders.*
The Hague, 1957.

To me, the most important thing is that men should not be the slaves of machines. In other words, machines should be owned by those who use them as a means of production. That is why I insist on the principle of co-operation. It would be much easier to organize the new factory on capitalistic lines, but why should I do it? Should I work for the interests of the capitalists and intensify the sufferings of the people? The profit secured from the improved technique should go to the people who share in the production.

My other conviction is that the silk industry has been, and should remain, a rural industry. My reason is that if we attract the industry away from the village, as has been done by many industrialists and is so easy to accomplish, the villagers will in fact starve. On the other hand, I know very well how the workers are living in the cities. Village girls have been attracted by the opportunity to work in the city factories for a small wage, on which they can hardly support themselves. They have left their own homes. This process has ruined both the city workers and the village families. If Chinese industry can only develop at the expense of the poor villagers, I personally think we have paid too much for it.

The aim of my work is to rehabilitate the rural economy through the introduction of scientific methods of production and the organization of the new industry on the principle of co-operation.

Fei Hsiao-Tung (3), 'Peasant Lofe in China[1] f 1936].
In *Chinese Village Close-up.* **Peking, 1983, 97-8.**

中國科學技術史

李約瑟著

莫朝鼎

JOSEPH NEEDHAM

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VOLUME 5

CHEMISTRY AND CHEMICAL TECHNOLOGY

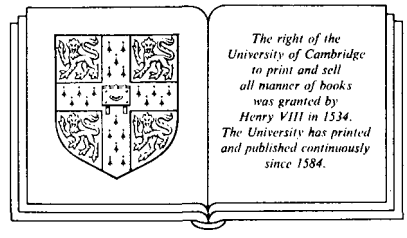
PART IX

TEXTILE TECHNOLOGY: SPINNING AND REELING

BY

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This book is dedicated to the memories of

HSIA NAI

and

OHTA EIZÖ

To the Memory of My Father

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LIST OF ABBREVIATIONS

The following abbreviations are used in the footnotes. For abbreviations of journals, Chinese and Japanese book collections, see pp. 437-478.

CCMF	*Chung Chu Ma Fa,* +1901
CCTC	*Ching Chi Yen Chiu*
CFP	*Chhün Fang Phu,* +1621
CKKTCW	Anon. *(109)*
CMYS	*Chhi Min Too Shu,* + 533 to +544
CWTTT	Chang Chhi-Yün *(3)*
EB	*Encyclopaedia Britannica*
EC	Hummel (a)
FCSH	Anon. *(644)*
FJHC	*Fu-Jen Hsiieh Chih*
GTL	Koch & Satlow (1)
HSCS	*Han Shih Chih Shuo,* + 12th or + 13th century
HTS	*Hu Tshan Shu,* +1874
KCT	*Keng Chih Thu*
KTSS	*Kuang Tshan Sang Shuo,* +1863
KTSSCP	*Kuang Tshan Sang Shuo Chi Pu,* +1875
MB	Goodrich & Fang (1)
MHT	*Yü-Thi Mien Hua Thu,* +1765
MLTW	Li Chhang-Nien *(2)*
NCCS	*Nung Cheng Chhüan Shu,* +1639
NCCSCC	Shih Sheng-Han *(8)*
NFTS	*Nan Fang Tshan Shu*
NS	*Nung Shu,* +1313
NSCS	*Nung Sang Chih Shuo,* + 12th or + 13th century
NSCY	*Nung Sang Chi Yao,* +1273
NSISTT	*Nung Sang I Shih Tsho Too,* +1314
PFKI	*Pin Feng Kuang I,* +1740-42
PMTT	*Pien Min Thu Tsuan,* +1593
PTHHCT	*Pien Tung Hsiieh Hai Chhün Tu,* +1607
SB	H. Franke (19)
SBB	Hervouet (2)
SIKH	*Shou I Kuang Hsün,* +1808
SILK	Anon. (609)
SNPY	*Shih Nung Pi Yung,* + 12th or + 13th century
SSTK	*Shou Shih Thung Khao,* +1742
STTH	*San Tshai Thu Hui,* +1609
SWCT	*Shuo Wen Chieh Tzu,* +121
TKKW	*Thien Rung Khai Wu,* + 1637
75	*Tshan Shu, c.* +1090

TSCMCS	*Tshan Sang Chien Ming Chi Shuo,* + 1888
TSCr	*Tshan Sang Chi Too,* + 1871
TSS	*Tshan Sang Shuo, c.* +1896
TSTP	*Tshan Sang Tshui Pien,* +1899
TSTL	*Tshan Shih Too Liieh,* Chhing
TTD	Anon. (606)
WHTK	*Wen Hsien Thung Khao,* printed +1322
WPCr	*Wu Pen Chih Yen, c.* + 13th century
WPHS	*Wu Pen Hsin Shu, c.* + 13th century
WTCT	*Wan Tung Cheng Tsung Pu Chhiu Jen Chhiian Pien,* +1609

FOREWORD

It gives me great pleasure to welcome the first of the two volumes which we are devoting in this series to textile technology. It is the work of my old friend Dr Dieter Kuhn, who spent three years with us in this Library before taking up a post in the Ostasiatische Abteilung of the Kunsthistorisches Institut at the University of Heidelberg. This first volume will be concerned with all the techniques of spinning and reeling of textile fibres for the production of the yarn needed for the warp and weft of the weavers. The second volume will be devoted to the history of looms.

There can be no doubt whatever that it is highly desirable to have these two volumes on the history of textile technology in the *Science and Civilisation in China* series. One has only to remember that in the Chinese language *chi,* the word for loom, became extended to mean any kind of machine whatsoever.* How different this was from the situation in Europe. I always remember walking down a street at Senglea in Malta and seeing a side-street leading down to the quay, called Triq-il-Macina (the Street of the Crane). I felt at the time that nothing could better demonstrate the productive character of Chinese civilisation as compared with the mercantile character of the Western world. In Europe the machine *par excellence* was the crane; but in China it was the loom.

The whole silk industry was in fact one of the greatest achievements of the ancient Chinese people, indeed a technical triumph. So characteristic of their civilisation was it that it generated one of the names by which they were best known to our ancestors before the time of Christ, namely the 'Seres' - the Silk People.[b] Silk was not one of Francis Bacon's three inventions that changed the world, but it was one of the three commodities of civilised life, along with tea and porcelain, which Westerners came to want more than anything else - and would go to any lengths to get.[c] First the silkworm had to be domesticated, and that happened at least as early as the Shang. Then the immensely long staple of its continuous fibres'[1] generated a whole range of inventions - the driving-belt for the quilling-wheel and spinning-wheel,[e] already available at least as early as the Han; and then the application of water-power to spinning.' I shall never forget the excitement with which I first read the description of the silk-reeling machine in the *Tshan Shu* which Chhin Kuan wrote about -I-1090, though it must have been in operation many centuries earlier.[8] It was perhaps the first fully automated industrial machine, for the treadle worked by the person controlling the cocoons in the boiling water activated both the ramping-arm by means of a belt-drive, and also the rotation of the main reel on which the silk was laid down. Again this

» Cf. Vol. 4, pt. 2, p. 9.
" Vol. 1, p. 168.
[c] Hence the Opium Wars. Cf. Vol. 4, pt. 2, pp. 600-1, pt. 3, pp. 518-19.
[d] Cf. Vol. 4, pt. 2, pp. 107, 269.
[e] Vol. 4, pt. 2, pp. 102 ff., 266-7.
' Vol. 4, pt. 2, p. 404, fig. 627a.
[g] Cf. Vol. 4, pt. 2, Fig. 409, pp. 107 ff.

probably led to the multiple-spindle, twisting and doubling machine oflater times, and the application of water-power to it.[a]

It was hardly to be expected that the 'art and mystery' of silk-making could be guarded indefinitely, and it seems therefore that the technique travelled from east to west about + 550.[b] There is room for much further investigation about the Italian filatures oflater centuries, in order to find out how far they resembled their parents in China.

But silk of course was not the only textile known and used there. It belonged to the imperial court and the families of patricians and high officials; the common people made do with cloths of other kinds. Here Dieter Kuhn enumerates the plants which were used for giving bast fibres. It is a great happiness for me to have what we have long known, so clearly and admirably set forth. First of all, of course, there were the fibres of hemp *(Cannabis sativa),*[0] forming a fabric which must go back far into the Neolithic, and most probably preceded the invention of silk. Hemp cloths continued to be worn by the common people right down to the Ming or later; and one remembers that Pi Shêng, the inventor of moveable type, was described by Shen Kua as a commoner, i.e. 'a man in hempen cloth\[d] There was also ramie, or grass-cloth (from *Boehmeria nivea),* very much appreciated down to our own time for light clothes, worn in summer.[6] Again, there was vine-cloth, from a creeping vine, *Pueraria thunbergiana,* also still appreciated.[1] Lastly, there was a fibre from a kind of banana-plant, *Musa textilis?* A considerable part of this volume is devoted to the hand spindle-whorl, by the aid of which the yarn was made.

There were also the minor textile fibres, such as Chinese jute, from *Abutilon avicennae,,*[h]and fibres from the paper-mulberry, *Broussonetiapapyri/era.*[1] Our familiar flax *(Linum usitatissimum)* was never grown in China for its fibres that make linen, but rather for its oiU

Quite different from any of these was cotton (from *Gossypium spp.),* because it is a seed fibre, and not derived from the bast of the stem.[k] It must have been primarily Indian, and the story of its coming into China, though rather complicated, will nevertheless be treated in detail by Dieter Kuhn.

To sum it all up, I would like to hail the first of these two volumes on textile technology as a major contribution to our knowledge of what the people of ancient and mediaeval China could do. It only remains to wish these books every possible success, and to welcome them warmly into the series.

JOSEPH NEEDHAM

* Vol. 4, pt. 2, p. 404, fig. 627a.
[b] Vol. 1, pp. 181 ff., 185-6.
[0] Cf. Vol. 6, pt. 1, pp. 170-1.
[d] Vol. 4, pt. 2, p. 33; Vol. 5, pt. 1, pp. 201-2. In Confucius' time it was also the essential wear of scholars when fasting or mourning; *Lan Tu,* x, 7 (t).
[e] Vol. 6, pt. 1, pp. 89, 172, 453.
' Vol. 6, pt. 1, p. 86. This was the ' dolichos cloth ' of the older sinologists.
* Vol. 6, pt. 1, p. 453.
» Vol. 6, pt. 1, p. 173.
[1] Vol. 6, pt. 1, p. 344.
i Vol. 6, pt. 1, pp. 108, 174-5.
[k] Cf. Vol. 6, pt. 1, pp. 89, 101, 327, 346.

AUTHOR'S NOTE

When Joseph Needham suggested to me in the summer of 1976 that I should write section 31 'Textile Technology' for his *Science and Civilisation in China,* the complexity of the task in all its variety and richness could scarcely be grasped. It would be the first history of Chinese textile technology in a western language.

The conception on which we agreed at that time was that I should produce a kind of grand compendium, mainly based on recent Chinese and Japanese research, supplemented by western studies. Soon, however, such a project proved unfeasible for a number of reasons. Firstly, most of the Chinese research prior to the 1970s turned out to be superficial and strongly biased by self-interest in that it overstressed Chinese inventiveness and craftsmanship, but at the same time lacked technical accuracy. Only recently have research and publication facilities improved so considerably that they now point to a 'renaissance' in the study of Chinese textile history. Secondly, though Japanese work excelled in bibliographical thoroughness and in socio-economic significance, yet surprisingly most of it was wanting in clarity and knowledge of the details of the historic development of textiles. Thirdly, works in western languages suffer from the almost complete absence of new and original research; well known explanations are repeated over and over again.

Only after I had joined Joseph Needham in Cambridge in 1977 and had started to write the first manuscript, did the true nature of the undertaking become obvious. The task could not consist of combining our own research with already known information, because the latter was both incoherent and out of date; original fundamental research was needed, especially in the field of neolithic techniques, spinning with a spindle-wheel and silk-reeling. This went far beyond what was already published in China, Japan or the West, and a period pf intensive research followed. Progress was fast, and as a result a new outline emerged. Nevertheless it took four years of collecting, translating, interpreting, reconstructing and planning before a real start on the text could be made. The outcome is that there are to be two volumes on textile technology; this, the first, is concerned with spinning and reeling, while the second dealing with weaving will follow in due course.

To comprehend Chinese textile technology as a whole, one must consider both the basic materials and also the techniques by which yarn is produced. In this volume, therefore, we shall deal not only with the evolution of bast fibre spinning and silk-reeling—both basic techniques in the production of yarn and thread for weaving —but also with the raw materials themselves. This is necessary because even the construction and function of Chinese looms depended to a large extent on the quality and characteristics of such basic material as was available. We shall, then, be concerned here with fundamentals: the raw materials and the yarn producing techniques.

It would seem relevant at this juncture, and before describing Chinese developments to add an explanation about the theoretical framework of western thinking on technology and its history, for this is the context in which my study has to be seen. It is far beyond my scope to embark on the various theories of the history of technology, its aims, limits and methods,* but I should like to outline my understanding of the subject. I have tried to follow a traditionally accepted interpretation, expressed by Jack Simmons as follows:[b]

It must I think be perfectly clear that to understand lives, the ordinary activities of human beings in ages other than our own, it is indispensable to consider the technologies that served them, for they formed in many respects the very framework of those lives themselves. They may have been, to our way of thinking, very simple technologies. But the simplicity is relative to experience, to what went before: the advance to the wheel, whether on the ground or in the potter's hand, cannot be considered a less striking achievement than the development of the telephone or the radio in the past hundred years. The changes that new technologies wrought in the lives of those who could make use of them are evidently great, perhaps here and there fundamental.

We also have to be aware that many factors come together; that inventions, innovations and improvements take place in a historic context or as R. A. Buchanan has put it:°

The history of technology is about people, and the way in which people have made and done things, and the implications of these actions upon each other. It is this human content to the subject which gives it valuable relevance to the great temporary questions of our civilization and makes it important in the teaching of history.

The present relevance of these studies to the history of textile technology becomes evident when we compare silk-reeling, its machinery, and the working and market conditions of Sung, Chhing, and Republican times with those of today. Then we come to realise how factors other than technological ones have also influenced the development of a whole industry. For example, new standards of silk quality suitable for western markets (Chap, *(g),* (5), (iii)) made it necessary to set up western machinery towards the end of the 19th century. The new machinery did not increase the rate of productivity per capita (when including all employees and workers of the filature), but brought other advantages, such as an easier organization of work, lower transport costs, and production of silk all the year round. Furthermore, the workers now depended completely on the owners of the filatures; the whole social context and the local environment of silk production changed.

As a consequence of foreign investments, after 1949 new difficulties arose which had not been recognised before. Many textile specialists had left China, many others lost their jobs during the years of the cultural revolution and the time of the 'gang of four'. But to keep factories going, a certain number of qualified staff such

» A short survey can be found in Buchanan (i), pp. 13-27. The author discusses the various concepts under three sub-headings: 'History of technology and its contribution towards historical understanding', 'History of technology as part of physical history', and 'What is the use of the history of technology'.

* Simmons (1), p. 1.

0 Buchanan (1), p. 25.

as engineers and technicians are needed. In Wu-hsi, Kiangsu province and other places, I could observe in 1979* that many machines in a silk filature were covered with a thick layer of dust, the spindles had not moved for almost a year. Obviously there was nobody available who could repair them. Officially it was explained to me that these machines were temporarily out of use due to modernisation. But would it not have been more reasonable to do the modernisation in steps,/ one unit of machines after the other, to avoid a reduction of the rate of productivity at least of 60 % in this workshop for twisting thread? What is the use of machinery when technical staff is deficient? If we were to consider the problem a whole, we should soon realise that it is closely connected with education-policy, which was evidently a failure for decades.

But there are even more factors which should be taken into consideration in a programme of modernisation. Below, (Chap, *(g),* (6)) I have tried to analyse reasons why the multiple twisting-frame was superfluous in Ming times. I arrive at the conclusion that it was due to the organisation of silk production as well as for demographic reasons. When we look at the use of modern spinning machines in China, we discover that similar basic problems have not been solved but are still relevant as an example shows.[b]

For textile production, seen in the context of the Chinese national economy as a whole,[0] it appeared to me unreasonable to buy foreign high-speed spinning machines as was done in a wool-spinning factory near Peking[4] for several reasons. Such machines require fewer workers than the 'old-fashioned types', so the workers no longer needed in the production process have to bè employed in the administration of the factory, thus inflating the administrative body disproportionally. And as far as spinning, reeling and weaving are concerned, China does not need labour-saving machinery but more machines to create jobs for the enormous manpower available. The spinning machines made in China in the 1960s and 70s are adequate. There is no reason to replace them with modern machinery as long as they are working at reasonable cost. By saying that China does not need foreign high-speed spinning machines in order to produce quality yarn to weave cloth for export, I do not mean that there should be no technical improvements, but rather that smaller textile industries should be established all over the rural districts, primarily to improve textile supplies in these still neglected areas.

But the whole problem becomes even more complex when we regard the way in which modern western textile machinery was purchased in 1979.[6] The machines devised and produced in China did not constitute a real problem, either in setting up or in maintenance, because there are specialists available with the technical knowledge, but the situation was quite different with the foreign high-speed spinning machine, which may serve as an example[1] for the whole textile industry.

» **Kuhn (10), p. 9 in the Textile Files of the Needham Research Institute, Cambridge.**

•> ***Ibid.*, pp. 10-11.**

[c] ***Ibid.*, pp. 13-14.**

[d] ***Ibid.*, p. 11.**

[e] ***Ibid.*, p. n.**

' **We do not know whether the modus of buying foreign machinery has changed between 1979 and 1983.**

When a factory wanted to buy a new machine it applied for it at the appropriate department of the Textile Industry Ministry, a department which would have collected information on the type of machine required. It may sound unbelievable but in the case of foreign textile machinery, most of the machines were bought without having seen them at work, without knowing their shortcomings; the department relied solely on the data published by the western textile machinery manufacturer. It is natural that many of the Chinese factories felt 'cheated' by the western salesmen once the machine started production. Yet the planning bureaucracy was more to blame than the western manufacturer. When I was in China I asked the chief engineers of 36 textile factories* which of them ha4 ever been outside China. Not one had ever been abroad and only a few had even been to the Canton fair. They clearly suffered from a considerable lack of information. Furthermore, there is the language barrier. Most of the engineers and cadres do not speak or understand a single word of a foreign language, so they have to rely completely on translations which are generally made not by scientifically or technologically trained translators, but by graduates from the 3-year courses at the language schools. This complicates the whole situation enormously. In the long run only a better education and technological training will help to improve the general situation, and the production of textiles too.

Methods and means of education have changed over the centuries. The methods and private activities of the magistrate Wang Chen, author of the *Nung Shu* (Book on Agriculture) from + 1313, and colleagues of his can hardly be compared with the official position and administrative function of temporary Chinese cadres, but still they have something fundamental in common. They are working for the growth of the productivity-rate and an improvement in living conditions in order to secure economic and political stability. Then and now the task was a challenge, and only education of the people offers the key to the solution of the problem.

There is no reason to question the concept of education generally but there is every reason to question—at least theoretically—the concept of productivity-growth. When carrying out research on the history of textile technology, one soon feels puzzled by the obvious conflict between technical progress on the one hand and the mode of life of the producers (peasants and craftsmen) of textile products on the other. There was and is always talk about the improvement of living conditions by growth of productivity achieved with the help of technical innovations. Do living conditions really depend on the growth of productivity? Could there not be other factors more important? I am not an economist and so cannot answer these questions, but I should like to point out a-few facts which are worth considering.

In the case of basic yarn and thread production in the history of China, technical progress neither improved nor made worse the living conditions of the peasants who produced cloth and silk as a sideline to help them pay their taxes and to cover their own needs. As long as yarn and thread production was a seasonal business,

» ***Ibid.,-p.*** **7.**

a part of agricultural activity, all technical innovations led to an increase in productivity and the improvement of the quality of yarns and threads. Everyone (especially the government and merchants) except the producers benefited from this. The price of textile products, especially silk, always depended on the market price, which was determined by supply and demand. When supplies were high, the price was low, so silk breeders always had to take their usual share in the risk.

When we look at the history of weaving, I have to say that talk of 'the growth of productivity improving the living conditions of the individual' is of theoretical value only. In the professional weaving business there was generally no agricultural background. The weavers and other workers in both private and government run workshops, had to carry the burden of the technical progress in the textile field. I have already described their situation elsewhere:[a]

Although mechanisation and the invention of machinery and technical devices are not bad in themselves, we should free ourselves from development- and progress-patterns expressed and defined in terms of'wooden structures of looms', 'treadle-mechanisms', 'pattern-lifting devices', and so on. As history has shown, most of these technological achievements and inventions were not used to improve the life of the ordinary people. They increased the rate of productivity only but did not lead to a more creative or more original craftsmanship but only to a more economic one. This tendency which is quite evident in all manufacturing fields produced serious consequences for the artisans themselves, as for example the loss of freedom at work, and the ability of choosing working hours to their own liking. They were deprived of all chances to add to their general knowledge, or to their experience in other fields. Every technical development in this field of textile technology, however small and unimportant it may appear and may have been, intensified the working situation of the individual craftsman and increased his or her dependence on circumstances and conditions which were beyond the artisan's influence and control. Inventions (and innovations) meant higher specialisation, more division of labour, breaking down one job into several steps which were performed by different groups of workers which finally resulted in more efficient control in the workshops by the supervisors and masters. This control could be obtained because an average production rate produced by each of the particular devices and hence for the entire production process was easier to work out and to fix as a standard of productivity. So the loss of the artisan's freedom at work, his occupation, reduced his status to that of a cogwheel in the machine, helped to increase productivity and deprived him of many previously unquestioned prerogatives.

Working conditions cannot be separated from living conditions for the weavers. In pre-1949 they reflect the way of life of craftsmen and workers. Even today, weavers very often live on the factory or workshop compound, as I saw in Chhengtu, Szechwan province and around Nanking, Kiangsu province. The room used for work and for private life was often the same.

Many inventions, innovations and improvements in the field of spinning and reeling technology were made in the history of China. I have no intention of listing them all but would rather stress the significance of a few which were

» **Kuhn (8), pp. 404-5.**

important for China and, in some cases also, for other parts of the pre-Renaissance world.

There are many ways to write about textile technology. One could concentrate on the function of devices and machinery, or discuss the subject in strict chronological order, or focus on the influence of inventions and innovations on society. The number of possibilities diminishes when an author envisages a history of yarn and thread production which is to include the raw materials, manufacturing techniques, archaeological evidence, and textual sources, as well as interpretations and reconstructions of the functions of machines and other devices, and when he must make an attempt to explain the social and economic implications and consequences.

To maintain clarity throughout the text I have chosen a division into chapters on bast fibres (Chapters *(b)* and *(c))* and silk (Chapters (/) and *(g))* which are arranged according to topics, and within the topics basically in a chronological order so as to make evolution of the technologies visible. Only in Chapter *(d)* 'The Evolution of the Spindle-wheel', is it impossible to separate silk, bast fibres and cotton technology from each other, because the spindle-wheel was elementary to all three types of raw material.

The part on bast fibres includes the raw materials (Chapter *(b)),* among which are ramie and *Pueraria thunbergiana.* Both fibre plants played an important role in the history of textile production and textile economy from the neolithic to Yuan and Chhing times respectively. After dealing with the raw material, I discuss the significance and the origin of spinning and the hand-spindle spinning techniques (Chap, (c), (1-3)), then continue with a preliminary study—which is without parallel—on neolithic, Shang and Chou archaeological sites in China yielding spindle-whorls of various types (Chap, (c), (2-7)). (Professor Hsia Nai has kindly informed me that he planned for many years to publish his own research on spindle-whorls, but other tasks and duties prevented him from doing so.) From the excavation of spindle-whorls it is possible to deduce that textile products were manufactured in a specific area. The sites with spindle-whorfs tell us where and when textile production has certainly taken place or even may have started. On three maps the distribution and diffusion of whorls is indicated.

The 'Evolution of the Spindle-wheel' (Chapter *(d))* comprises its construction and working methods, textual evidence, and supplies reasons supporting the theory that it was invented in Chou China. Furthermore the application, function and dating of the treadle-operated multiple spindle-wheel—an improvement on the spindle-wheel of Chinese origin—are explained before the chapter closes, together with the advanced water-powered multiple spinning-frame for bast fibre yarns, a frame which displays Chinese inventiveness and craftsmanship at its best (Chap. (</), (5)).

Rope-making, a special type of bast fibre spinning technology, is traced in (Chapter («)) before we turn to silk. I start its history with the legends about sericulture and its deities (Chap. (/), (1)) and then proceed with early Chinese

archaeological and textual evidence (Chap. (/), (2)). Only then can the production of silk, its presuppositions, equipment and devices be described and interpreted (Chapter *(g)).* I focus on the various types of hand and treadle operated silk-reeling frames, on the importance of the reel and of self-crossing techniques for silk threads. I look into the economy of silk production and silk-reeling (Chap. *(g),* (5), (ii)), and finally (Chap, *(g),* (7)) discuss evidence of silk finds in Europe prior to the Han dynasty, as well as making a short comparison of silk machinery in East and West.

Even if Chinese sources had not provided evidence for so many inventions and improvements of textile spinning devices and machines, the study would appear to be worthwhile for its many references to an economic and social history of textile production in China which still has to be written. Indeed I have tried to reveal the economic context of yarn and thread production in order to show the extent to which the rural population was involved in the business. What is more, I have emphasised the role of the government and indicated how economic conditions influenced the development of technology in particular.

Having now given what seems to me essential general information about the scheme of this volume, I must leave readers to make their own judgement.

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Diyi mianfangzhi yinranchang 第一棉紡織印染廠 (Chengdu)
Chengdu Shujinchang 成都蜀錦廠
Chengdu Shuxiuchang Shuxiu chejian 成都蜀綉廠蜀綉車間
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Guoying Xibei diwu mianfangzhichang (Xi'an) 國營西北第五棉紡織廠
Guoying Zhengzhou disan mianfangzhichang 國營鄭州第三棉紡織廠
Zhengzhou fangzhi jichang 鄭州紡織機廠
Pimao disan chang 皮毛第三廠 (Beijing)
Beijing disan mianfangchang 北京第三棉紡廠
Maofangzhichang 毛紡織廠 (Beijing)
Beijing rongtanchang 北京絨毯廠
Nanjing yixin sizhichang 南京藝新絲織廠
Nanjing diyi mianfangzhichang 南京第一棉紡織廠
Suzhou zhenya sizhichang 蘇州振亞絲織廠

Suzhou cixiu yanjiusuo 蘇州刺綉研究所
Suzhou sichou yinhuachang 蘇州絲綢印花廠
Suzhou meishu ditanchang 蘇州美術地毯廠
Wuxishi saosi diyichang 無錫市繅絲第一廠
Wuxi sizhi yichang 無錫絲織一廠
Wuxi juanfangchang 無錫絹紡廠
Wuxishi saosi di'erchang 無錫市繅絲第二廠
Shanghai ditan zongchang 上海地毯總廠
Shanghai disanshiyi mianfangzhichang 上海第三十一棉紡織廠
Shanghai diyi chenshanchang 上海第一襯衫廠
Shanghai diqi maofangzhichang 上海第七毛紡織廠
Shanghai diwu yinranchang 上海第五印染廠
Shanghai pixiechang 上海皮鞋廠
Shanghai disan sizhichang 上海第三絲織廠
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D.K.

Heidelberg

31. TEXTILE TECHNOLOGY

(a) INTRODUCTION
THE PRODUCTION OF YARN AND THREAD IN CHINESE HISTORY- SOURCES, INTERPRETATIONS AND RESULTS

It can be regarded as common practice to begin a study of this type with an introduction, though not one which bears the characteristics of a concluding chapter. Yet we have chosen this way of presenting a few Chinese sources, explaining our intentions, and giving some results for three reasons. First, the reader unfamiliar with the raw materials for and basic techniques of textile production should not be plunged into a 'sea of bast fibres and silkworms' without a lifebelt nearby. This introduction will, we hope, act as such a lifebelt.

Secondly, we shall summarise a few of the major results of our study in order to demonstrate the cultural importance of inventions in the textile field to both East and West. Such results should be not only of general interest to the 'Republic of Learning' but also help to clarify our arguments.

Thirdly, as we shall be quoting many passages from Chinese sources, the reader should be told something about the nature and reliability of these works before they are referred to in the body of the text. One of these, the *Nung Shu* (Book on Agriculture) of +1313 written by Wang Chen, will particularly deserve the utmost attention.*

Before people in China could weave cloth on a loom, they had to learn about the raw materials from which to obtain textile fibres; they also had to gain experience in the preparation of fibres (splicing, spinning, twisting) in order to make them durable, strong and suited to the weaving process. Only then could the threads of bast fibres be dressed on a primitive loom without running the risk of warp breakages all the time. On early bast fibre looms a certain length of cloth could be woven. The length was defined by the distance from each other of the functional parts to which the warp-threads were fixed. Scholars have speculated that the earliest loom of this type may have used warp-threads stretched between the weaver's belt at one end and a peg in the ground or a tree at the other. A two-beam backstrap-loom, also called a body-tension loom, with the warp fastened to the two beams may have developed from the former type. Later—but at least as early as Shang times—these fundamental parts of the backstrap-loom acted as cloth-beam and warp-beam due to the influence of silk-weaving.[b]

The discovery of the quality of silk fibres which could be reeled off from the

[a] Bray (1), pp. 59-64.

[6] Kuhn (8), pp. 388-9; Sung Chao-Lin (1), fig. n (Yunnan); Roth (i), p. 10,figs. 6,7 (Ainu, Japan); Leroi-Gourhan (1), pp. 300-1, fig. 52a (Ainu, Japan) ; see also d'Harcourt (i), p. 611 ; Newman (1), p. 64.

cocoons in continuous lengths of several hundred metres, of practically 'endless' silk threads of almost uniform tensile strength and elastic structure, led to the invention of a rotary reel, the only device Which could wind the silk filaments to their best advantage. Such a reel in the form of a rotary warp-beam and rotary cloth-beam was placed in a horizontal loom made of wood. In this way weavers could produce silk fabric with a length of several metres, the quality of silk determined the structure and function of the loom at least as early as Shang times.[a]

But prior to weaving the threads into fabrics, the bast fibres and silk filaments had to be obtained and processed.

As far as we can tell from the Chinese, both past and present, the growing of hemp, ramie and other bast fibre plants as well as the breeding of silkworms took place in the rural areas and not in the urban centres of China. This was mainly for two reasons. In the first place, growing plants and breeding silkworms—which always meant planting mulberry trees—demanded space which could not be spared in cities. Second, all activities connected with the production of raw material for textile fibres and their processing were distinguished by their labour intensity. The harvesting season dictated the time schedule of the work, and all members of the family, and often cheap hired hands as well, were needed to do the job in time. The processing of fibre plants and cocoons had as a rule to be executed immediately after harvesting. There could be no postponement, otherwise the material would decompose or be destroyed, as was the case with the cocoons when the moths inside them were allowed to escape.

Only towards the end of the 19th century has the introduction of western silk machinery facilitated to some extent the processing of cocoons; but basically the rearing business has continued unchanged until the present time.

Throughout Chinese history, spinning bast fibres and reeling silk were considered to be household duties for women, and so were mostly executed by the female members of the peasant class, either in the households of the peasants themselves or in workshops owned by the local gentry. Judging by Chinese sources we may say that yarn production constituted a sideline in the family budget, and should generally be considered as a seasonal cottage industry. The general living conditions of the peasants, which depended on official policy, the ability of the authorities to keep law and order, and on the occurrence of natural disasters, determined the working conditions and circumstances of bast fibre spinning, and silk-reeling. Hence the socio-economic history of the yarn producing peasant households is the history of the peasants of pre-modern China.

The history of weaving—which is not discussed in this study—took another course. On the one hand, we find peasant households which produced tabby-weave fabrics of a certain standard in size and weight in order to be able to pay their tax in kind. On the other, there were private and government-run loom workshops. Setting up various types of loom required a considerable financial investment

» Kuhn (8), p. 390.

which had to pay off, and such workshops produced silk fabrics of high quality and of complex structure in countless variety, catering to all tastes and fashions. In the professional weaving trade, living conditions depended on many more factors; their social and economic history is more complicated. We know, for example, that from + 10th-century Sung times, female weavers worked and lived in government-run workshops under rather unpleasant working conditions.* And in Yuan times artisan status was hereditary, the artisans enjoying the privilege of exemption from miscellaneous corvée duties.[b] During the Ming supply and demand dictated the working conditions of weavers.[0]

Thus the peasants who mastered the basic techniques of yarn and thread production as a cottage industry, and with their production methods defined by the rural environment, greatly differed in life and working situation from the professional highly specialised silk weavers in the loom workshops situated in the cities. Their living and working conditions, their methods and devices, and their financial investments had nothing in common; in consequence they have to be investigated separately. The link between the textile cottage industry and the weaving workshops was, of course, the manufacturing of textile products.

We must now ask, where did all the inventions in the field of spinning and reeling take place? It is difficult to produce a working hypothesis to answer this question as it would have to include the inventions and improvements made, as well as the manufacture of the machinery, and apply to all periods of Chinese history. Though it may be questionable to rely on logical reasoning to join the various pieces of information together, the method appears to be justified as long as no better and more conclusive interpretation exists which would take all the various points into account.

In attempting to find an answer, it is necessary to summarise silk producing techniques.[4] We have already mentioned the importance of silk-reeling techniques, in particular the significance of the rotary reel for the development of the horizontal silk loom in China. In the field of spinning and reeling techniques, the rotary reel constituted the absolute key invention. In all probability, artisans of the Shang silk workshops had improved its technical features in order to make it more efficient, and by Western Chou times and in the Spring and Autumn period, the reeling device had already spread into all silk producing areas. At the beginning of the Warring States period, when political struggles favoured a change of economic conditions, and commercial trade activities had started to flourish, the old textile producing techniques could no longer satisfy increased public and private demand. A treadle-operated loom was invented both to weave silk cloth

• Eichhorn (14), p. 199, n. 3.

[b] Chü Chhing-Yüan (1), pp. 237-40.

[0] Anon. *{644),* [20]7-[1]7i [2]37> the years from + 1596 to + 1626 were characterised by uprisings of artisans and craftsmen in all traditional centres of craftsmanship, including Suchou, Hangchou and **Peking, tee Gernet (4),** p. 365. To some extent the quality of work influenced the wages paid to the **weavers, see Ebrey** (3), **pp. 141-2.**

[d] The development of spinning is explained and documented in chap. (c). Hence we can **summarise its** contents in a few sentences.

faster and to provide more uniform quality than the old loom could do. This new generation of looms needed more efficient spinning devices, so it is probable that it was the artisans who took the small step of making use of a rotary reel and a horizontally arranged spindle for winding thread. This thread winding arrangement finally led to the invention of the spindle-wheel, which at the beginning may have been employed for silk only, but shortly afterwards served for the spinning of bast fibre yarn as well.

The question 'who invented the spindle-wheel and the treadle-operated loom?' cannot be answered definitely. I may reason that these ingenious inventions were made by artisans in a textile workshop owned by a wealthy aristocrat or an official; or even a government office may have been in charge of such a workshop, as they were in charge of craftsmen in the Spring and Autumn period.[8] From the year — 588, we hear that one hundred each of mechanics, female embroiderers and weavers were sent from the state Lu to Chhu as hostages.[1] It is in the context of such conditions of production that the invention and innovations of textile machinery must have taken place. In Han times, private textile workshops are well documented and ample pictorial evidence of the spindle-wheel and the treadle-operated loom is available from Shantung and Kiangsu provinces.

There can be little doubt that improvements of spinning and reeling machinery in Sung times occurred in affluent silkworm breeding households and households of the economically liberal-minded gentry. Compared with the millions of peasant households, their yearly silk output constituted a small percentage only. But they alone had the neo-Confucian political consciousness and financial means to invest in machinery. The peasants profited from the existence of such advanced machines by renting them if they could afford it, or they may have tried to make them themselves. But there is every reason to doubt whether they would have possessed the knowledge, money and tools to construct them successfully. We say this because we know that weavers, for example, did not build their own looms but bought them from 'loom-carpenters',[0] specially trained craftsmen *(tzu-jen[1])*.[d] In the government workshops of Ming times, loom-carpenters *(chi-chiang[2])* were employed to build and to repair them[6], and for making of reels, reel-wrights *(huo-chiang[3])*[1] are mentioned. So there is a high probability that a division of labour in the field of the manufacture of advanced textile machinery was generally practised throughout Chinese history, so that spindle-wheels and silk-reeling frames may well have been manufactured by artisans specialised in these crafts.

We must turn now to another question: what was the driving force behind all these inventions and innovations in the field of spinning and reeling devices?

As long as we have no economic and social history of textile production in

* **Cho-Yün Hsü (3), p. 12.**
[b] ***Chhun Ckhiu Tso Chuan Cheng I,* vol. 2, ch. 25, p. 1897; see also Cho-Yün Hsü (3), p. 12.**
» **Brook (i), p. 173.** **d Kuhn (3), pp. 1-3.**
[8] *Ta Ming Hui Tien,* ch. 289, p. 2583. ' ***Ibid.* p. 8577.**

[1] 梓人 [2] 機匠 [3] 弩匠

China, we can only offer a valid explanation here in the context of the general conditions prevailing in agricultural production. Two factors are relevant. The first is the natural properties of silk. We have already learned that the reeling of silk required a rotary reel, so one essential invention which characterised the development of Chinese textile technology as a whole took place because of the natural properties of silk fibres. The structural appearance of the primitive pre-Shang reel may have been a product of experimental practice over a long period. The reel used in the Shang silk workshops of the — 2nd millennium certainly resembled the reels of later times, as may be deduced from Shang pictographs. Secondly, the changing economic conditions and the increasing demand for more textile fabrics, stimulated the development of better devices in order to make possible more efficient means of production. The main periods of technical innovation and improvement of textile spinning and reeling devices, namely the Chou and the Sung period—as far as they could be established in this study—are characterised by social mobility and commercial activity. It appears highly probable that the search for new solutions in policy and economy created an atmosphere* generally favourable to private entrepreneurs. Furthermore, increased commerce and trade, and in Sung times the burden of tribute payments to the northern neighbours, may have contributed to the decision to look for more profitable ways of textile production. Though such general conditions in middle and late Chou and Sung times certainly helped to accelerate the speed of development, we have to remember that the philosophical understanding of scholar-officials constituted the fundamental basis for the encouragement of textile crafts like spinning and reeling within the framework of agriculture in Chinese society. This specifically Chinese way of economic understanding, which has prevailed throughout Chinese history, always put emphasis on the development of agriculture in general.[b] Gale stated:° 'Prior to the Han period, the statesmen and scholars of China had all, irrespective of the "school" of thought to which later centuries assigned them, stressed the importance of agriculture. Farming was looked upon as the fundamental of national wealth; industry and commerce as merely accessory to the cultivator.'

The idea of agriculture as the basis of a nation's wealth may have originated in the justified and permanent fear of bad harvests and famine, a source of danger to the rulers and the government. And it may have been the care about the people's welfare which brought about the idealistic view that production of agricultural goods and their consumption should be looked on favourably. The same view was certainly held for the products of spinning, reeling and peasant weaving, works which were regarded as belonging to agricultural activity. When the 'natural' balance was lost due to incompetence, extravagance or luxury, everything was bound to get into disorder.

» Hsü Cho-Yün (3); Gernet (2).
» Kaplan (1), pp. 49-51, 69-71, 76-8, 96-9, :29-32.
[c] Gale (1), p. xx.

In the *Ten Thieh Lun* (Discourses on Salt and Iron) of *c.* — 80 we find a passage expressing this idea of 'favourable balance':[a]

If the seasons of husbandry are not disturbed there will be more grain than can be eaten. If silkworms and hemp are raised according to the seasons, cloth and silk will be more than what is required to wear.[b]

And the consequences of the production of luxury textiles are expressed as well :°

If the women folk decorate the small things and work on minute and elaborate articles to the best of their skill and art, then there will not be enough silk and cloth to wear.

This conclusion—expressed in the spirit of a traditional Chinese view—'hits the nail on the head'. The production of luxury textile products, and consequently the expansion of the silk trade, created 'superfluous' markets distracting people's attention and energy—not to speak of the money spent—from essentials. Trade and luxury goods, in the opinion of Chinese officials, led away from the basic activities securing the survival of the empire—urgently needed cereals and textiles required for maintaining the armed forces, to pay tributes and the salaries of officials.*

The conflict between the economic policy of the government and the interests of consumers was always in evidence. On the one hand artisans manufactured expensive and fashionable fabrics to meet the demands of the aristocracy, the gentry and rich merchants, who made use of the material to display their social position and their wealth; on the other, officials reprehended the manufacture of such goods and trading in them in particular. The Chinese did not find a key for solving this contradiction either theoretically or practically; edicts such as those issued in the 8th year of the emperor Kao-tsu of the Han dynasty (— igg)[e]— prohibiting a number of fancy fabrics to the merchants—and in the 6th year of the reign Ta-li of emperor Tai-tsung of the Thang dynasty (+ 771)[1]—prohibiting the production of expensive weaves—could not help the problem.

The champions of the reform movement of the +1 ith century in Northern Sung dynasty were well aware of this conflict and made every effort to succeed with the new policy they had in mind for stabilising and improving the basis of state finances. The leading figure of the movement was the reformer Wang An-Shih[1] (+ 1021 to + 1086),* a physiocrat as all Confucians were apt to be. He did not follow the conventional Confucian theory of a balance which would only be valid in a static economy, but held the opinion that the government should stimulate productivity.[11] He expressed this idea as follows :[1]

» **Gale (i), pp. 23-4.**
[b] ***Ibid.*, p. 23, n. 8, the extant Mencius text differs from the text of the Han era.**
[c] ***Ibid.*, p. 24.** [a] **Gernet (4), p. 128.**
[e] ***Han Shu*, ch. 1 *hsia*, p. 65.** ' **Hsü Than *(1)*, vol. 2: i, p. 51.**
* ***SB*, vol. 3, pp. 1097-1104.** » **Liu (2), p. 50.**
[1] ***Un Chhuan Wen Chi*, ch. 70, p. 79; Williamson (i), vol. 1, pp. 300-1 ; Liu (2), p. 50.**

[1] 王安石

If the State improves its institutions so as to make the (productive) base grow strong and the (consumer) end diminish, then the wealth of the country will be so great that no matter how much the State uses it cannot possibly exhaust all of it.

So his view is quite clear, promoting agricultural output, the production of food and textile products, emphasising irrigation works and at the same time favouring a heavier tax burden on the merchants (and on luxury items) rather than on the peasants.* His views may have favourably influenced the innovation and setting up of textile machinery used in the spinning and reeling processes. Regrettably, there is no written evidence to back up this assumption.

We may summarise: the traditional concept of economy was based on agriculture. Spinning and reeling were classed as agricultural activities. This economic context generally favoured, and sometimes encouraged, inventions and innovations for the benefit of society as a whole. Commercial activities in the silk trade and the production of luxury silk fabrics may have promoted innovations and improvements in textile machinery.

In the mind of government officials, agriculture always played the dominant role. It was not only considered to be of high educational value but in practice it also constituted the basis of the various taxation systems practised in China. Even in times when the agricultural results fell short of expectations, solutions to the problem were always sought within the traditional theoretical framework of economic reasoning.[b] The various dynasties tried to solve the crisis of state finances by land- and taxation-reforms. But what did the government do to increase the productivity of peasant households, to improve the living standards of the rural population? Which educational measures were taken to propagate sericulture and the basic textile arts in general?

To answer these questions we should look at literature on the subject. Yet we soon discover that the fact that agriculture and sericulture constituted the basis of the nation's wealth is not reflected in official publications. Among the comparatively few lost works on sericulture about which we have information, we have not come across one single title which might have been composed to imperial order. Among the extant works written for educational purposes or of a descriptive character, only two comprehensive and informative works were commissioned by the government, namely the *Nung Sang Chi Yao* (Compilation on Agriculture and Sericulture) of + 1273 and the *Shou Shih Thung Khao* (Complete Investigation of the Works and Days) of +1742.° All the other publications were written by scholar-officials who tended to stress the significance of the subject for the benefit of the empire or had a personal interest in sericultural and agricultural matters. If we take the lost books, often quoted in other Chinese works and hence discussed in the relevant chapters below, and add to them the number of titles of lost books on sericulture listed here, we not only obtain information of bibliographical

* Liu (2), pp. 50-1. [b] Gernet (4), pp. 281-2, 268-9, 331-2.
[e] Bray (1), pp. 71-4. For a short review of agricultural works see Shih Sheng-Han (7).

interest but we also gain an idea of the modest volume of publications on this subject compared with literature, philosophy and other topics. The numerical impression we receive reflects the contradiction between theoretical knowledge and practical experience among scholar-officials. The bibliographical evidence is notable for its scarcity.

The following works are lost:[a] from Thang times we know of two *Tshan Ching* (Book on Sericulture);[b] in the + 11th century the scholar Teng Yü-Fu (died + 1107) composed his *Nung Li* (Almanac of Agriculture)[0] in 120 chapters; the *Huai-Nan-Wang Tang Tshan Ching* (The Book of Rearing Silkworms in the Tradition of Huai-Nan)[d] of Northern Sung times or even earlier was written by an unknown author; another lost work titled *Keng Sang Chih Sheng Too Pei* (Manual of Important Preparations which have to be Done to Make a Living from Agriculture and Sericulture)[e] was composed by Ho Hsien-Chüeh in +1127 and had a preface dating from + 1153. Two other works titled *Nung Sku* (Book on Agriculture) date from the + 12th century, one of them was by Liu Chhing-Chih (+ 1130 to + 1195),[1] the other by an unknown author.[8] Miao Hao-Chhien published his *Tsai Sang Thu Shuo* (Illustrations and Explanations on the Planting of Mulberry Trees)[h] *c.* + 1318. This work was printed by imperial order. The *Nung Sang Tsho Tao* (Selections from Agriculture and Sericulture)[1] by Lo Wen-Chen was of Chin or Yuan times and appears only in bibliographies. From Ming times we know of the *Tshan Sang Chih* (Record of Sericulture)[5] by Chhen Kho-Jen, of the *Tshan Phu* (Treatise on Sericulture)[1]* by Hsii Wen-Tsao of the late +i6th or early +i7th centuries and of the *Nung Sang Chi Tao* (Compilation on Agriculture and Sericulture)[1] by Yü Ju-Chieh. The *Tshan Shuo* (Explanations on Sericulture)[1]" of the + 18th century by Wang Jung-Hsü is also lost.

Among the Chinese agricultural and sericultural encyclopaedias, books and articles still extant, are many compiled according to the favoured scissors-and-paste method. Such works do not help us discover new explanations' for the development of Chinese textile technology. There are other works but these do not concentrate on technical matters, rather pursuing general educational, sometimes economic aims, and in this context it is not possible to do them justice. The most important and informative works on the subject of our study—often referred to in the following chapters—are not included in the list below. In Ming times Huang Hsing-Tseng composed his *Tshan Ching* (Book on Sericulture)." Ku Yen-Wu (+1613 to +82)[0] wrote an article on *Fang Chih Chih Li* (Advantages of

» Lost means that at present no copy can be located; it does not necessarily mean that a book has disappeared for ever. In i960, for example, a Korean print of + 1590 of the *Ssu Shift Tsuan Tao* (Collection of the Essentials of the Four Seasons) of Thang times was discovered. So a book is now available again which had been lost for many centuries.

[b] ***Hsin Thang Shu*, ch. 59, p. 1538.**
[c] **Amano *{8)*, pp. 77-8.**
[ä] ***Sung Shut*, ch. 205, p. 5205.**
[e] **Amano *{8)*, pp. 86-7.**
['] ***Ibid.*, p. 90.**
[e] ***Ibid.*, p. 91.**
[h] ***Ibid.*, pp. 115-16.**
[1] ***Ibid.*, p. 114.**
[>] ***Ibid.*, p. 156.**
[k] ***Ibid.*, pp. 155-6.**
[1] **Amano *{8)*, p. 182.**
[m] ***Ibid.*, p. 229.**
[»] ***PLHS.***
[0] ***EC*, pp. 421-6.**

Spinning and Weaving) between +1670 to +1682 an essay trying to promote these crafts in north Shensi;* educational papers entitled *Chiao Tshan* (Teaching Sericulture)[b] and *To Phin* (Laziness and Poverty)[0] were written by Thang Chen from Szechwan province in the + 17th century; a most probably incomplete work with the title *Nung Sang Cking* (Book on Agriculture and Sericulture)[4] by Phu Sung-Ling (+ 1640 to +1715)[6] dates from *c.* + 1705. The *Nung Sang I Chih Lu* (Record of Easy Knowledge about Agriculture and Sericulture)* by Cheng Chih-Chhiao was printed in + 1741. Yang Shen, author of the *Pin Feng Kuang I,* composed in + 1756 the *Tshan Cheng Chai Too* (Selected Essentials from the Management in Sericulture).[8] Li Pa of the + 18th century composed an article *Tshan Sang Shuo* (Explanations on Sericulture) .[h] Li Yü-Chhiu wrote the *Sang Chih* (Record of Mulberry) in 10 chapters,[1] Han Meng-Chou published in the + 18th century his *Tang Tshan Chheng Fa* (The Perfect Method of Rearing Silkworms) ;[J] Chhen Hung-Mou[k] wrote the *Chhüan Chung Sang Hsi* (Encouraging the Planting of Mulberry Trees)[1] in +1751, and his *Chhang Chung Sang Shu Hsi* (Introducing the Planting of Mulberry Trees)[m] is from +1757; from the same year comes his *Kuang Hsing Shan Tshan Hsi* (Report on the Widespread Wild Silkworms).[11] It may be of interest to note that Chhen held the position of governor of Shensi province in the years + 1756 to + 1757. Chou Khai composed his *Chhüan Hsiang Min Chung Sang Shuo San Tse* (Discussing the Three Rules Encouraging and Assisting People to Plant the Mulberry Tree)[0] towards the end of the +i8th century. The same author wrote *Chung Sang Shih Shuo* (Discussion of Poems about Planting Mulberries) .[p] Probably in the early 19th century, Chhen Pin composed the *Tshan Sang Tsa Chi* (Miscellanies on Sericulture).*[1] In *c.* + 1825 Sung Ju-Lin gave some instructions in his *Thung Chhih Chkien-Sheng Chung Hsiang Tii Tshan Hsi* (Circular Instructions about the Planting of the *Quercus sinensis* to Rear Silkworms in Kueichou Province).[1] In + 1829 Yang Ming-Yang published his *Tshan Sang Chien Pien* (Short Compilation on Sericulture).[8] The *Shan Tso Tshan Sang Khao* (Investigation into the Sericulture of Shantung Province)* by Lu Hsien dates from + 1835. In the Kuang-hsü era, Chang Wen-I published his *Tang Tshan Mi Chieh* (Secrets of Silkworm Breeding),™ in *c.* +1898 or later the *Tshan Sang Chi Too* (Compilation on Sericulture) by Cheng Wen-Thung appeared.

After having cast a glance at the titles of lost and, for our study, 'irrelevant' works which document private interest in sericultural matters, we must now look

* *HCCSWP,* printed in + 1827 (reprint Taipei, 1963), ch. 37, pp. ia-2a.
» *HCCSWP,* ch. 37, pp. 3ab.
[d] Amano *{8),* pp. 628-30; contained in *PSLC.*
' *CSTK;* Amano *{8),* p. 221.
[11] *HCCSWP,* ch. 37, pp. I4a-i6a; Amano *{8),* p. 228.
i *NHTS;* Amano *{8),* p. 229.
[1] *HCCSWP,* ch. 37, pp. ioa-11 b.
[n] *HCCSWP,* ch. 37, pp. i2a-i3b.
» *HCCSWP,* ch. 37, pp. 233-253.
[r] *HCCSWP,* ch. 37, pp. 27a-28a.
« Amano *{8),* pp. 244, 259.
« *HCCSWP,* ch. 37, pp. 4ab.
[e] *EC,* pp. 628-30.
« Amano *{8),* p. 228.
' *LSSC;* Amano *{8),* pp. 243-4.
* *EC,* pp. 86-7.
[m] *HCCSWP,* ch. 37, pp. 8a-ga.
° *HCCSWP,* ch. 37, pp. iga-22a.
« *STTSKHC;* Amano *{8),* p. 244.
[s] *CCTS;* Amano *{8),* pp. 252-3.
[u] *THCTSP;* Amano *{8),* p. 286.

at the sericultural 'classics'. Apart from the *Nung Sang Chi Too* (Compilation on Agriculture and Sericulture) commissioned by the imperial government, the works of a number of scholars have survived, such as the *Chhi Min Too Shu* (Important Arts for the People's Welfare) of *c.* +533 to 544 by Chia Ssu-Hsieh, the short but technologically important *Tshan Shu* (Treatise on Sericulture) of *c.* +1090 by Chhin Kuan,[a] the *Nung Shu* (Book on Agriculture) of +1149 by Chhen Fu, the *Nung Shu* (Book on Agriculture) of + 1313 by Wang Chen, the *Thien Kung Khai Wu* (The Exploitation of the Works of Nature) of +1637 by Sung Ying-Hsing, the *Nung Cheng Chhüan Shu* (Complete Treatise on Agriculture) of + 1639 by Hsü Kuang-Chhi and a few others.

They may help us realise that there was a relatively small number of scholar-officials who were concerned in practice about the essentials of life with a feeling of responsibility not only towards their private ends, but also for the nation as a whole. This idea we find expressed in the preface to the *Chhi Min Tao Shu,* where we read that Chia wrote his work to instruct the youngsters of the family.[b] Sung Ying-Hsing thought his publication of some value to the scions of noble houses and the imperial princes.[0] These learned scholars displayed their knowledge about, and their experience in, sericultural and other agricultural matters in order to make the 'myriads of things and phenomena' visible. At the same time, it appears obvious that they designed their works for the management of private estates* and for the use of government officials who could read them as manuals. Landlords and stewards of estates may well have managed agricultural and sericultural affairs in accordance with local traditions and certainly must have consulted such works. Peasants and tenants could have been instructed by them while agricultural and sericultural manuals also belonged to the luggage of magistrates and other officials, as was also the case with other books of a practical kind.[6] These Confucian scholars clearly distinguished themselves by their ideals, preoccupations and fancies, from the generally known type of scholar-official. Sung Ying-Hsing expressed this notion in his preface as follows:[f]

A person who is endowed with intelligence and possesses a knowledge of the natural world is much respected by the multitude of ordinary folk. Yet there are those [we may add that such people constitute the majority of the well-bred and educated class] who, not being able to distinguish between jujube flowers and pear blossoms, would prefer to indulge in speculations about the water-plants of Chhu; not knowing the measurements and care of cooking pots, would prefer to discourse emptily on an ancient sacrificial vessel of Lü...

The scholar-official and physiocrat Wang Chen and his *Nung Shu* of +1313—a milestone in the history of the world of treatises on agriculture—may serve as

[8] The *Hsi Wu Tshan Lüeh* (Summary of Sericulture in West Kiangsu) of + 1845 by Chheng Tai-An follows in parts the *Tshan Shu* by Chhin Kuan.
[6] *CMTS,* **ch.** *hsü* (preface), p. 7a; Bray (1), pp. 56-8.
[c] Sun (1), p. xiii.
[d] In Ming times a number of popular-encyclopaedic works existed for this purpose, **see Kuhn (a).**
[e] **McKnight (1), pp. a-4.** ' Sun **(1),** p. xiii.

model for the genre. It provides evidence of the Confucian creed of scholars like him, and may help towards a better appreciation of their publishing activities in the field of agriculture and sericulture; it could be labelled 'enlightened' within the theoretical framework of Confucian reasoning.

Only a few details are known of Wang Chen's life and career. His literary name was Po-shan[1]. He lived towards the end of the + 13th and in the early decades of the + 14th century in Yuan times. His native home was in Tung-phing[2], nowadays Tung-phing-hsien in Shantung province. In + 1295 he held the position of magistrate in Ching-te-hsien[3], Anhui province while later in his career he was transferred to Yung-feng-hsien[4] in Kiangsi province. He may have died in the 2nd decade of the + 14th century after his *Nung Shu* was published.* As a native of Shantung, he had some experience in the northern methods of agriculture and sericulture, as we may conclude from the many details based on empirical data described in his work. He very probably started to compose his *Nung Shu* during his term of office at Ching-te-hsien, and had finished it by *c.* + 1302 to +1303^

The history of the various editions of the *Nung Shu* is quite complicated :° we

» **Wang Te-I *(1)*, vol. i, pp. 127-8; Changjun-Sheng, Chhen Shih-Chün *(1)*, pp. 266-795 Wang Yü-Hu (*). P- 445-**

» **Chang Jun-Sheng, Chhen Shih-Chün (/), p. 266; Wang Yü-Hu *(2)*, p. 445. *Ten-Tüan Wen Chi*, ch. 7, pp. i6a-i 7a. There is a problem over dating the work. We do not know the reasons why its publication was delayed for many years until + 1313. In a paragraph about printing from movable type, Wang Chen informs us that the *Nung Shu* was finished at least one decade earlier. The relevant paragraph is translated in Carter, Goodrich (1), pp. 216-17. 'When I was district magistrate in charge of the magistracy of Ching-te in the district of Hsüan-chou, I composed the *Nung Shu.* However, inasmuch as the number of characters used in that book was very large, I found difficulty in having it printed from blocks. I therefore followed an idea of my own and had artisans make for me movable type. This work was finished in two years. Then as an experiment I printed the official records of the district, using for the purpose about sixty thousand type or more. . .Two years later I was transferred to the magistracy of Yung-feng in the district of Hsin-chou, and when I went to my new office I took the type with me. At this time the *Nung Shu* had just been finished and I wished to have it printed with movable type. I then found out, however, that printers in the province of Kiangsi had already begun to cut the blocks for this work. Therefore I laid the type aside in order to await another opportunity for their use....' Chang Jun-Sheng, Chhen Shih-Chün (1), p. 279 indicate that Wang Chen printed the official history of Ching-te in + 1298. Though this date would fit neatly, we could find no definite confirmation of it. Twitchett (12), p. 75 mentions the publication but cautiously avoids providing a date.**

[c] **The various editions are discussed in Wan Kuo-Ting *(11)*, pp. 68-72; Wang Yü-Hu (2), pp. 1-14; Amano(S), pp. 111-13; Kuhn (1), pp. 16-21 (here the bibliographical references of the various editions listed below can be found) :**

Print of-(-1313

***(Tüan khan-pen*)*, lost.**

Print of + 1530

(Ming *Chia-ching khan-pen*[6]*)*, in 36 ch.

Print of + 1574,

published in Chang-chhiu-hsien' (*Wan-li khan-pen*)*, the title appears only in bibliographies.

Print of + 1617

***{Wan-li Teng-mei khan-pen*[9]*)*, in 36 ch.; a reprint of the +1574 edition. We have never seen this edition in a library.**

Print of + 1774

***(Chhien-lung wu-ying-tien huo-tzu-pen*[10]*)*, completed in + 1783 in 22 ch. This edition was based on the *Tung Lo Ta Tien* manuscript, ch. 625-37 which is no longer extant.**

[1] 伯善 [2] 東平 [3] 旌德縣 [4] 永豐縣 [5] 元刊本
[6] 明嘉靖刊本 [7] 韋邱縣 [8] 萬曆刊本 [9] 萬曆鄧渼刊本 [10] 乾隆武英殿活字本

have consulted the edition of + 1530 in 36 *ckiian* and the edition of + 1774 in 22 *chiian.* To refer to two editions is justified by the different quality of the illustrations in them.[a] The *Nung Shu* consists of three sections with the headings *Nung Sang Thung Chiieh*[1] (Comprehensive Secrets of Agriculture and Sericulture), *Ku-Phu*[2] (Treatise on Cereals) and *Nung Chhi Thu Phu*[3] (Illustrated Treatise on Agricultural Implements).[b] In all probability, parts of the *Nung Chhi Thu Phu* section are based on the *Nung Chhi Phu* (Treatise on Agricultural Implements)[0] of +1 ith century by Tseng Chih-Chin, with a preface by Chou Pi-Ta (+ 1126 to + 1204) and originally dedicated to Su Tung-Pho[4] (+ 1037 to +1101). Regrettably, the work has been lost since Ming times.[4]

In his preface to the *Nung Shu*—dated as stemming from the 15th day of the third month of the year *kuei-chhou*[5] of the reign Huang-chhing * (which is the year +1313)—Wang Chen states:[6]

Agriculture is the important basis of the Empire *(nung. thien-hsia chih tapenyek*[7]*).*

With regard to the importance of agriculture, this sentence corresponds to the first sentence in the *Yuan Shih* (History of the Yuan (Mongol) Dynasty), subsection *Nung-sang* (Agriculture and Sericulture) where we read:[f]

Agriculture and sericulture are the basis of royal government *(nung sang, wang cheng chih pen y eh*).*

For Wang Chen the empire as a whole including all inhabitants, constituted the basis of all agricultural efforts. The Yuan rulers stressed in this statement a political idea. But this difference should not be overestimated, because emperor Shih-tsu[9] (Kublai), immediately upon ascension to the throne, proclaimed to the empire:[8]

The nation has the people as its basis. The people have food and clothing as their basis. Food and clothing have agriculture and sericulture as their basis.

The edition of + 1530 may have been consulted for all the parts which were missing in the *Tung Lo Ta Tien* manuscript.
Print of + 1895
***(Kuang-hsii Fukien tseng-kho wu-ying-tien chii-chen-pan tshung-shu-pen*[10]*),* edition in 36 ch. based on the + 1530 edition.**
Print of + 1899
***{Kuang-hsii Kuangtung fan-kho wu-ying-tien chii-chen-pan tshung-shu-pen"),* in 36 ch.**
Print of + 1898
lithographic print *(Kuang-hsii shih-yin pen*[11]*),* in 22 ch.

» **See below, chap, *(f),* (1), (ii).**
[b] **For details about the number of *chiian* and the arrangement of the three sections, see Kuhn (1) pp. 20-1.**
[c] ***Sung Shih,* ch. 205, p. 5207.** [d] **Amano *(8),* p. 97.** [e] ***MS* (preface).**
[f] ***Tiian Shih,* ch. 93, p. 2354.** * ***Ibid.*, Schurmann (1), p. 50.**

[1] 農桑通訣 [2] 穀譜 [3] 農器圖譜 [4] 蘇東坡 [5] 癸丑
[6] 皇慶 [7] 農、天下之大本也 [8] 農桑、王政之本也 [9] 世祖
[10] 光緒福建增刻武英殿聚珍板叢書本 [11] 光緒廣東翻刻武英殿聚珍板叢書本
[12] 光緒仿印本

Wang Chen has put it differently, more drastically and in a way more readily comprehensible to all readers. He said:[a]

A man who does not plough, may suffer from hunger, a woman who does not weave may suffer from cold.

This threat—quoted here from Han sources'»—always constituted a real factor in the life of the ordinary people. Wang Chen wisely qualified this quotation by adding that the wise men of antiquity paid attention to the work of the people, stressed the importance of agriculture, taught the people to plough the fields, to weave, to grow plants and to breed animals.[0] So he could be regarded as a scholar-official following in the ancients' footsteps—at least he made an effort to do so.

His educational actions fitted quite well into the general policy of the Yuan rulers who had an interest in promoting education in the field of agriculture and sericulture. The government did not confine itself to the publication of the *Nung Sang Chi Too,* but appointed special officials and established new offices. In the *Yuan Shih* we read:[d]

In the first year of Chung-thung [+1260 to + 1261] (the government) ordered the *hsiian-fu-ssu** of each *lu*[2] to select persons well versed in agricultural matters and appoint them as agriculture-encouragement officials for all areas. In the second year (the government) established the *chhiian-nung-ssu*[3] (Agriculture-encouragement Bureau)...

In the seventh year of Chih-yiian [+1270 to +1271], the *ssu-nung-ssu** (Bureau of Agriculture) was established... (It) was established to concentrate on the management of affairs relating to agriculture, sericulture, and irrigation. In addition, (the government) assigned agriculture-encouragement officials and irrigation experts to patrol the prefectures *(ckiin-i*[s]*)* and investigate diligence or indolence (in the administration of the agriculture-encouragement programme). The magistrates in charge of civil administration *(mu-min-kuan*[6]*)* in the area in question were to be in control of agricultural matters...

Apart from administrative regulations I do not know how the encouragement programme was performed in practice. Here we should ask again the magistrate Wang Chen. To put it in his own words ' how can the customs of people be changed ? '

The answer is by education. In his clearly organised book, he noted what he had seen and heard about agriculture and sericulture; he compared the old techniques with the modern ones, the techniques applied in the north with those

» ***NS* (preface).**

[b] *Han Shu,* ch. 24, p. 1128; see also, *CMTS,* ch. *hsii* (preface), p. ia, quoted from *Kuan Tzu*[1]. Hsia Nai would prefer a different translation. ' One man does not plough, someone may suffer from hunger due to him, one woman does not weave, someone may suffer from cold due to her.' (Private correspondence, 16 June 1984.)

[c] *NS* (preface).

[d] *Yuan Shih,* ch. 93, p. 2354; Schurmann (i), pp. 50-1.

[1] 宣撫司 [2] 路 [3] 勸農司 [4] 司農司 [5] 郡邑
[6] 牧民官 [7] 管子

of the south. Often he not only described and explained them, but also advised the farmers which was best to use.

Tai Piao-Yüan[1a] (+ 1244 to + 1310), professor, scholar and official, colleague and probably friend of Wang Chen, composed a preface to the original edition of the *Nung Shu;* he may have written it around + 1302 or + 1303, but in any case before + 1310, the year of his death. In his preface[1]» he compared the magistrate Wang Chen with the famous official Tzu-Chhan[2] of the —6th century and the *Nung Shu* to the *Pin-feng* (Customs of Pin), a part of the *Shih Ching* (Book of Odes). He described Wang Chen as a Confucian scholar-official of a rare type, getting involved in agricultural matters, teaching the farmers of his administrative region to plant mulberry trees, all kinds of hemp, ramie and cereal crops. Wang Chen made drawings of all sorts of agricultural implements, which were used by farmers for manufacturing their tools. This happened during his term of office in Ching-te-hsien, Anhui province. It will not surprise us to hear that the officials of other regions ridiculed him and that even his own minor officials regarded his methods as unsuitable. Yet Wang Chen obviously convinced the farmers of the usefulness of his agricultural methods. After three years he had gained a high reputation among the people and had established his authority due to his educational activities. His authority guaranteed civil obedience to law and order and civilised behaviour in his area of administration. Tai Piao-Yüan realised the benefit of his method and hence admired Wang Chen's administrative skill and his conduct as Confucian scholar and official.

Six years later in Yung-feng-hsien, Kiangsi province, the magistrate Wang Chen proceeded as before in Ching-te-hsien and increased his reputation by his educational activities. Obviously he reached his goals very fast as manifested in the agricultural output of the area, so he retired to his studio in the mountains and led a quiet life. People willingly obeyed his orders; he was regarded as 'father and mother of the people', a perfect official, an ideal Confucian.

In the opinion of Wang Chen, this was the way that the customs of people could be changed and improved; he gave an answer to the question within the framework of Confucian thought. So it appears quite natural that the *Nung Shu* was regarded as a book useful to scholar-officials, as a manual to be used for education of the people.

So far we have heard about the economic situation, the Confucian consciousness and educational activities in the field of agriculture, about the 'change of customs', which means making use of suitable and advanced methods to improve the techniques traditionally applied. We must now turn to the plants themselves, to archaeological objects and textual sources to provide evidence of the presence, cultivation and development, in order to see their practical importance in daily life in China.

* Wang Te-I (J), vol. 4, pp. 2063-4.
[b] *Ten-Tüan Wen Chi,* ch. 7, p. 17a; Wang Yü-Hu *(s),* p. 445.

[1] 戴表元 [2] 子產

(b) BAST FIBRES AS RAW MATERIAL FOR THE PRODUCTION OF TEXTILE FIBRES

The task of describing plants and tracing their use and distribution constitutes a challenge to anybody who has not received a training in botany. Nevertheless, we have tried with the presuppositions given, to outline the characteristics and the properties as clearly as possible, and dare to hope that this will be rewarded by sufficient understanding for our purpose. We have selected certain bast fibre plants according to their usefulness in our context.[11] Only a few agricultural details and textile technological aspects of these plants can be taken into consideration here, otherwise the vast amount of information about bast fibres would far exceed the length of a chapter without adding new facts relevant to our discussion.

Among the plant fibres used in the production of textiles, ramie, hemp, and the vine-creeper, *Pueraria thunbergiana* (better called bean-creeper) possessed the greatest economic and cultural importance in pre-Yuan China; fabrics of banana fibre were highly esteemed among Chinese literati and upper-class people. At that time, cotton had not yet gained its dominant position in the central parts of China as a plant for providing textile fibres. All four plants had been known in China for many centuries, however. Though their characters are not found on Shang oracle-bones and Chou bronze inscriptions, they are mentioned in various literary sources of the Chou period;[b] with the exception of banana fibres which occur in Han times.

To obtain the fibre material, the Chinese peasants used similar processing techniques for all these long staple bast fibres, and knotting or glueing with saliva was a common way of splicing them to make a continuous yarn (Fig. i).° That the Chinese distinguished hemp from ramie may be seen from a passage in Wang Chen's *Nung Shu*:[A]

> The appliances used for hemp and ramie are not the same in the south and in the north of China. How can the customs of people be changed? As the people of the south do not understand the reaping of hemp, so the people of the north do not know about the treating of ramie.

Wang Chen's remark mirrors the traditional Chinese understanding which may have come into existence hundreds of years before his time. In the neolithic Yang-shao period hemp was probably the only fibre plant grown in north China;[e]

» They are identified after Terrell (i) and Jackson (i).

[b] Textual evidence will be produced below when discussing the plants in detail.

[c] Hemp must not necessarily be spliced but, to judge from Chinese sources, the splicing of fibres was performed, see below. <• *NS*, ch. 22, p. 1 a.

[e] Andersson (3), p. 26; Chang (1), p. 196; Li Hui-Lin (6), pp. 437-9. A fragment of a coarse hemp fabric (thread-count: 11 warp-threads: 11 weft-threads per cm) was found with others at Ta-ho-chuang in Yung-ching County, Kansu province in i960. The site is attributed to the Chhi-chia culture and dated to -2150 to — 1780. Anon. *{539)*, M 75:1, pi. 6, fig. 2.

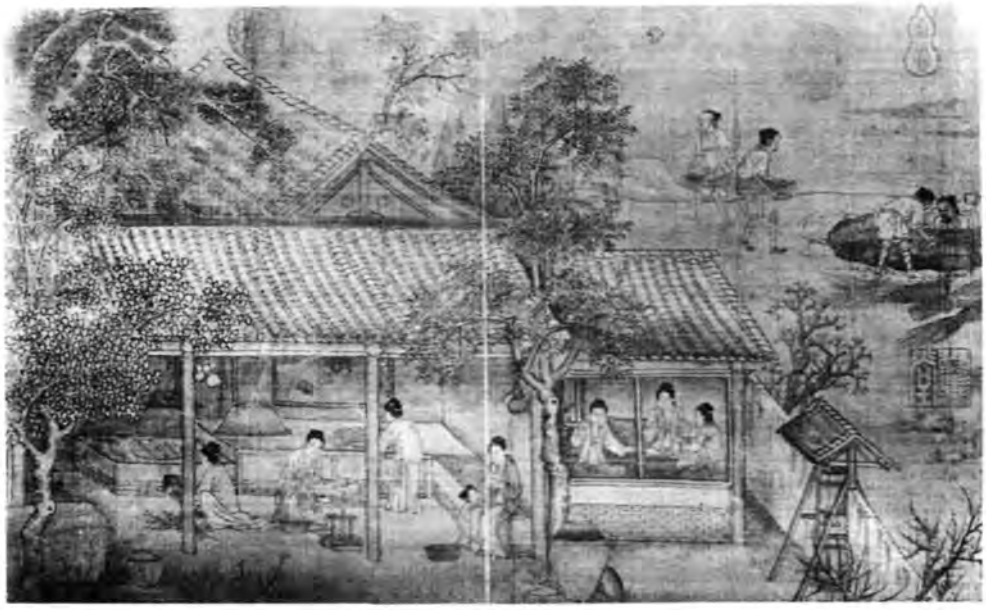


Fig. 1. Processing hemp. Section of a handscroll by Liu Sung-Nien (*c.* +1150, died after +1225). National Palace Museum, Taiwan (VA 35c).

the cultivation of ramie took place in the Yangtse area and to the south of it.[a] So hemp and ramie in north and south China respectively possessed the same importance as textile raw material as the wild form of flax *(Linum angustifolium)* around the Mediterranean, and the domesticated type of flax *(Linum usitatissimum L.)* in Egypt. It is doubtful whether such a division of fibre-giving plants into north and south in accordance with Chinese tradition can be maintained. Hemp fragments were discovered at a neolithic site in Chekiang province,[b] while the statement of Wang Chen certainly cannot be regarded as valid from Sung times on,[c] when the people also practised the growing of hemp in the deep south, and the cultivation of ramie in the north, too. The Ming scholar Sung Ying-Hsing says of his time:[d] 'In every region of China ramie is grown.'

Although we have chosen the traditional order of presenting bast fibre plants, starting with hemp, followed by ramie and all the others, there are considerable differences in the economic value attached to them which are not reflected in the order of presentation. Judging from Chinese sources and contrary to our western assessment, ramie as a fibre for weaving fabrics played a more important role than hemp in medieval and pre-modern China.

[a] At the neolithic site of Chhien-shan-yang three pieces of ramie cloth have been found. The site is dated — 2750+ 100. In the first piece the thread-count shows 23:23 per cm in warp and weft. The warp-threads are roughly twice the weft-threads in diameter; both show a Z-twist direction. The second fragment has a thread-count of *c.* 16:16 per cm; the threads are Z-twisted. The third find counts 30:20 threads per cm in warp and weft, which are S-twisted. See Anon. *(757),* p. 86.

[b] Wang Chi-Ying, Mou Yung-Khang (j), pp. 353-8.

[c] Sudö *(4),* pp. 321-62.

[d] *TKKW,* ch. shang, p. 44b.

Cannabis saliva (L.) was of economic importance in north China and ramie, *Boehmeria nivea* (L.) Gaudich, a nettle plant, in south China. Fragments of ramie, dated as being from the — 3rd millennium, have been excavated in the north of Chekiang province. At least as early as Chin times (+ 3rd century) ramie was spreading north from the Yangtze river region into the area of the Central Plain. Before that time it may have been known as a wild plant in a few districts of the north.

The success story of ramie is mirrored in Chinese agricultural literature, where it received far more attention than the hemp plant with regard to its usefulness as a material to be processed into textile fibres. What led to the success of ramie?

Hemp is an annual plant, ramie perennial. In terms of textile fibre production this means that compared with hemp, ramie yielded double or triple the amount of fibres in a year, roughly 20 to 30 kg per 1000 square metres per harvest. A ramie plantation once established could be exploited for up to 15 or 20 years without showing signs of reduction in productivity.* The plant is easy to grow and proper manuring guarantees a good crop. The properties of the fibre are excellent. It is not only greater in tensile strength than any other known plant fibre, but it also almost equals silk in its brilliant lustre. It successfully resists atmospheric changes, is very little affected by moisture, and dries easily even in regions with high humidity. The quality of the ramie thread produced varied from coarse to extremely fine, and all qualities of fineness were within the range of the spinners' abilities.

Why did ramie not supplant hemp in the course of time? There are several reasons for this. Firstly, hemp was an attractive plant for an agricultural society. It could supply the textile fibre material, as well as oil when the seeds were crushed and a psychotomimetic drug. Secondly, hemp can be planted in regions colder than those suitable for ramie and in altitudes of 1200 m above sea-level, roughly the limit for ramie. And thirdly, hemp fibres are easier to obtain from the stem of the plant than ramie fibres.

Threads made of hemp are usually below Nm 20 (m/g) in quality, so we may assume that hemp was mainly used to weave coarse fabrics and to manufacture ropes.

Hence hemp has no paragraph in the textile section of the *Thien Kung Khai Wu* (The Exploitation of the Works of Nature), but is only mentioned in the chapter 'The Growing of Grains', where we read :[b] ' ...and the coarse cloth woven from its bark fibres is of very little worth'.

To do justice to the bast fibre plants and their use by the Chinese in the — ist millennium, we shall produce some pre-Han textual evidence which may help to indicate in a basically agricultural society, the significance of such textile material both to aristocrats and landowners as well as to the peasants themselves.

[a] Wagner (1), p. 357.

[6] **Sun** (1), p. 24. One paragraph in **the** chapter ' Clothing Materials' deals with ramie and **a few other** bast fibre plants, pp. 63-4.

Your hemp robe *(ma-i[l])* is bright like snow»

we read in the collection of early folk and ritual songs, the *Shih Ching* (Book of Odes)—composed in Western Chou times and in the Spring and Autumn Period.[b]

Freshly bright is her ritual robe, it covers the ko crape *(tsou-chhih[2])* and that is the plain garment *(hsieh-fan[3])* worn next to the body; oh your clear forehead, the colour of. your forehead! Truly a person like that, she is the beauty of the country.[0]

The *Shu Ching* (Book of Documents) contains the *Tii kung** chapter (generally considered to be a chapter written in the period of the Warring States), which deals with the tributes paid by vassals to the emperor. These tributes consisted of local products; among items such as silks, feathers and fur, it mentions hemp *(hsi[s])* and fine cloth *(chhih[6])* of the bean-creeper *ko* from the Tai[7] valley in Chhing-chou[8d] in the northeast of Shantung province, which was roughly the territory of the two states Chhi« and Lu[10]. It also mentions hemp *(hsi),* fine cloth *(chhih)* and ramie-cloth *(chu[11])* from Yu-chou[I2e], the region of the Central Plain of Honan and Hopei. From the *Tso Chuan* (Master Tso's Tradition)—composed around —468 to —300*—we hear that a robe made of ramie *(chu-i[13])* was presented as a tribute in the year — 543.[8] The *Lieh Tzu* (Book of Master Lieh) says:[h]

In winter fur, in summer cloth of the ko plant is worn *(tung chhiu hsia ko[1]*).*

But this may not have been the rule. In the winter of — 600 there was no hemp, so people started to use the *ko* plant to make their winter cloth and other items.[1]

Even geographical places were named after the occurrence of the *ko* plant, which reflects its importance in the economic system of a rural community. We hear, for example, in the year —717 that the Sung soldiers besieged a city named *Chhang-ko[lsi]* ('long bean-creeper') nowadays in Hsü-chou[16], Honan province; another battle took place in the year —706 at *Hsii-ko[17]* ('bean-creeper for fine fabrics'), perhaps a local product.[11]

So far we may have got the impression that the textual evidence about bast fibre textiles is scattered in various sources but if we consult the *Chou Li* (Record of the Institutions (lit. Rites) of the Chou (Dynasty)), which most probably contains material from the late Chou period, and provides us with descriptions of all government official posts and their duties and the *Li Chi* (Record of Rites)

[1] Karlgren (14), p. 94, no. 150. b Hsü Gho-Yün (3), p. 183.
[c] Karlgren (14), p. 31, no. 47.
* Medhurst (1), p. 93; Karlgren (12), p. 14 (6).
[e] Medhurst (1), p. 102; Karlgren (12), p. 15 (15).
« Karlgren (8), p. 64-5.
B Yang Pai-Hsün *(1),* vol. 3, p. 1166. » *Lieh Tzu,* ch. 5, p. 14a.
[1] Couvreur (1), vol. 1, p. 595. > *Ibid.,* vol. 1, p. 37.
[k] *Ibid.,* vol. 1, p. 83.

[1] 麻衣 [2] 縞絺 [3] 紲袢 [4] 禹貢 [5] 枲 [6] 絺
[7] 岱 [8] 青州 [9] 齊 [10] 魯 [11] 紵 [12] 豫州
[13] 紵衣 [14] 冬裘夏葛 [15] 長葛 [16] 許州 [17] 繻葛

ascribed to the Former Han (though the earliest pieces included may date from the — 5th century) then we realise that the production of bast fibres and the cloth made from them, occupied a place of some economic importance both in the official administration and within the ritual context of Chinese traditional behaviour and custom. Whether the content of the works indicates standards of administrative bureaucracy and imperative rules of conduct may be questioned, but without doubt they provide us with a vivid impression of those guide-lines to morals and organisation which the Chinese at least in theory held in high esteem, and to which they aspired.

So we learn that in the Chou palace the director of the hemp department *(tien hsi[1])** was in charge of the production of bast fibre cloth, and that there were coarse hemp cloth *(ssu[2])*[h]—made of fifteen hanks comprising eighty threads each, the so-called fifteen *sheng^-cloth.*—hemp yarns *(lii*)*[c], ramie cloth *(chu*[s])*[d] and other types of cloth made of bast fibres like the bean-creeper *(ko)* and the abutilon hemp or jute *(chhing[6]).* There was also a supervisor of the *ko* department *(chang ko[7])*[e] in charge of collecting the raw material supplied at various seasons by the peasants in the mountain regions. The material was used to weave fine cloth *(chhih[9])[1]* and coarse cloth *(hsi[9])*[s]. Paid as tax, it had to fulfil certain standards in weight and length. An ordinary Chinese of the Warring States period furnished the state not only with a fixed contingent of grain, but also with cloth woven by his wife, which was due in the summer, like silk. Furthermore he was subject to the annual labour service.[11]

In his study on Chou times Hsü Cho-Yün pointed out that the character *pu[10]* denoted a certain type of spade-shaped money and hemp cloth, both of which served as a commodity of exchange.[1] The length of one unit of such 'cloth money' may have measured forty *chhih (c.* 11 m) in Han timesJ Its width may have been determined by the loom, the structure of which made a cloth width of 50 to 60 cm

[a] *Chou Li Chu Shu* (The Chou Li with Assembled Commentaries) in *Shih San Ching Chu Shu* (Edition of the Thirteen Classics with Assembled Commentaries, Including the *Shih San Ching Chiao Khan Chi)* by Juan Yuan of +1816 (repr. Shanghai, 1980), vol. 1, ch. 8, p. 691 (top).

» *SWCT,* ch. 13 *shang,* p. 13b. « *SWCT,* ch. 13 *shang,* p. 9b

[d] Following the explanation given in the *SWCT,* ch. 13 *shang,* p. 13 b, *chu* is the coarse cloth made from a grassy plant *chhing[11]* which can also be understood as abutilon. hemp. The fine cloth made of this raw material is called *Milan".* It appears rather unlikely that *chu* is made from anything else but *chu" Boehmeria nivea.* Regrettably *chu* is mostly said to have been obtained from a *ma[1]** plant without specification. But interestingly enough the *Tit Phien* defines *Milan[12]* as fine cloth (made from the) *ko* plant, see *Til Phien,* ch. *hsia,* p. 47. Hence we may conclude that there existed no absolutely reliable definition.

[e] *Chou Li Chu Shu,* ch. 9, p. 700 (middle); ch. 16, p. 748 (middle).

' *SWCT,* ch. 13 *shang,* p. 13a; *hsi-pu[5].*

[B] *Ibid.,* ch. 13 *shang,* p. 13a; *tshu-pu[16].*

" Legge (3), ch. 7.2.27. Hsü Cho-Yün (3), p. 113.

1 Hsü Cho-Yün (3), p. 123.

i *Ibid.,* p. 21!, n. 99: That a piece of cloth with a length of two *chhih* had a width of one twentieth of a *chhih* should not be considered as a general standard; see *Li Chi Cheng I,* in *SSCCS,* vol. 1, ch. 13, p. 1345 (top).

[1] 典枲 [2] 緦 [3] 升 [4] 縷 [5] 紵 [6] 績
[7] 掌葛 [8] 絺 [9] 綌 [10] 布 [11] 絲 [12] 紵
[13] 苧 [14] 麻 [15] 細布 [16] 粗布

most practicable. In Han times set standards of quality, length, width and weight were quite common for silk fabrics; even the place of production might be laid down. Most probably, similar standardisation of measures of bast fibre cloth would have been declared valid in the Warring States period.[0] A thirty-one character inscription dating from the Eastern Han period which was found on a fabric in Tun-huang[1] says:[b]

A double-thread silk fabric *(chien[1])* from Jen-chheng* Kingdom [established +84 in Shantung province], Khang-fu county. The roll has a width of 2 *chhih* 2 *tshun* [50.68 cm] and a length of 4 *chang* [9.21 m] ; its weight is 25 *Hang* [347.5 g]. It is 618 coins of money worth.

The *Li Chi* and its commentaries confirm the existence of standards in size and quality. Plant fibre cloth measured a width of 2 *chhih* 2 *tshun* and silk fabrics 2 *chhih* 4 *tshun.*[c]

It seems that women performed the tasks connected with textile production. Thus in *Mo Tzu* we read:[d]

Early in the morning the women rise, late in the night they go to bed, spinning and weaving *(fang-chi chih-jen*)* they do; they process the hemp, the silk and the bean-creeper in all ways *(chih ma ssu ko[s]),* they roll up the woven hemp cloth and the silk fabric; that is their share in the work (of a household).

After taxes had been paid in cloth and the needs of the household had been covered, the surplus could be sold in the nearby market-place.

But not only the life of ordinary women was dominated by work with textiles; the women belonging to the upper class shared the same lot (at least in theory) :[e]

... the young wife is the fitting partner of her husband performing all the work in silk and hemp, weaving fabrics of bast fibres and silk (i *chheng ssu ma pu po chih shiffi).*

Certainly the celebrated young wife had enjoyed a typical girl's education.

A ten year old girl no longer leaves the quarters of women. The governess teaches her speech and manners, docile and obedient behaviour. She instructs her to work hemp, to reel silk cocoons, to weave cloth of hemp (including fillets and tassels), to study all women's work.. .and how to tailor robes.[1]

Even within the palace compound, one of the nine classes of work executed by the concubines consisted of transforming silk threads and hemp fibres.[8] The concubines, assigned to their work in groups of nine by the administrator of the

*** See the seal impression *nü um shih?* on a Warring States silk fragment; Hsiung Chhuan-Hsin (j), \ pp. 49-56; pi. 1.**

[b] Stein (4), vol. 1, pp. 373-4. Lubo-Lesnichenko (1), p. 18.

[0] *Li Chi,* ch. 3, pp. 30 ab.

[d] *Mo Tzu,* ch. *Fei-j>iieh-shang[a]*, ch. 8, p. 160; Schmidt-Glintzer (1), vol. 2, p. 117.

[e] *Li Chi,* ch. 10, p. 11 b. « *Li Chi,* ch. 5, p. 81 a.

[g] *Chou Li Chu Shu,* vol. 1, ch. 2, p. 647 (top).

[1] 敦煌 [2] 縑 [3] 任城 [4] 紡績織紝 [5] 治麻絲葛
[6] 以成絲麻布帛之事 [7] 女五氏 [8] 非樂上

interior, were under the supervision of a concubine of the second grade; they wove silk fabrics, cloth from hemp *(tsu-hsiin[1])** and did all kinds of needlework.[1]»

The quality of cloth tailored into court robes *(chhao-fu[2])*[c] by the textile department of the palace workshops had to reach certain standards. It was woven with fifteen hanks *(sheng[3])* which means 1200 warp-threads. Assuming that hemp cloth had a width of *c.* 50 cm with twenty-one warp-threads to one centimetre, it was rather fine, compared to the seven *sheng* cloth quality with eleven warp-threads to the centimetre. The threads were treated with ashes so as to make them smooth. The *Li Chi* also informs us that gifts from the king, be they robes or chariots, were not for sale; furthermore, all the fine and coarse fabrics made of bast fibres *(pu*)* or silk *(po[5])* on sale had to meet the official standards in quality, size and colour. Figured fabrics *(chin-wen[6])* were generally not allowed to be offered for sale.[d]

Regulations were in existence prescribing the outfit in which one was allowed to enter the palace compound: the ruler's gate could not be passed without robes dyed in the correct colours nor could a person enter in a fine or coarse robe made of the bean-creeper fibres, nor with a fur robe.[6] It was also a tradition that silk worn under or inside linen was contrary to the rule.[1] Even when bathing, upper class people were expected to conform to certain sophisticated rules; these clearly show that rules of conduct existed for all situations in life. After bathing the upper class man used two towels, one of fine cloth *(chhih)* for the upper part of the body; another of coarse cloth *(hsi)* for the lower part.... In his bathing robe of cloth, he dried his body again, put on his shoes and was served a drink.« The act of washing the body by taking a bath was indeed transformed into a ritual.

Bast fibre plants, particularly hemp, played an important role in the manufacture of hemp bandages *(chiao^)*, for simple sheets *(chin[8])*, sewn together from five single pieces, and in shrouds *(chhin[9])* for a corpse.[h] They were used, too, for clothes used by mourners, and in fact a system existed for rating bean-creeper cloth and hemp cloth as mourning robes.[1] The general remark that at the mourning rites a robe of sackcloth *(ma-tshui[10])* was worn with a white headband made of the male hemp plant *(mu-ma-tieh[11])**, can easily be elaborated by presenting a short description of the five kinds of mourning dress *(wu-fu[12])* as they are documented in the Zî *Chi*:[k]

*** Originally the characters described tassels, fringes and bands.**
» *Chou Li Chu Shu*, vol. 1, ch. 7, p. 884 (bottom).
» *Li Chi*, ch. 7, p. 55 a. d *Bid.*, ch. 3, pp. 30 ab.
e *Li Chi*, ch. 6, p. 12 a. ' *Ibid.*, ch. 6, p. 11 b.
e *Li Chi*, ch. 6, p. 5 a.
[11] *Ibid.*, ch. 3, p. 34a; ch. 8, p. 14a.
[1] *Ibid.*, ch. 10, p. 14a.
I *Ibid.*, ch. 2, p. 25 b.
*** *Ibid.*, ch. 10, pp. gb-i2b; here we can point out only a few of the regulations concerning mourning garments.**

[1] 組訓 [2] 朝服 [3] 升 [4] 布 [5] 帛 [6] 錦文
[7] 絞 [8] 紟 [9] 衾 [10] 麻衰 [11] 牡麻絰 [12] 五服

1. When mourning for parents the *ckan-tshui*[1] was worn. The weavers made it from the female hemp plant *chii*[2],* which has an unpleasant appearance, and thus the internal distress of the mourner was displayed outwardly. Only three hanks of hemp threads (243 threads) constituted the width of *c.* 50 cm, which means 5 warp-threads to one centimetre. A very coarse fabric indeed. It was worn for three years (really 27 months), normally with unhemmed borders.
2. When mourning for grandparents and great grandparents the *tzu-tshui*[3] was worn. Made of fibres obtained from the male hemp plant *hsi*[4]> the warp-thread count was 6 to 10 per cm (4 to 6 *sheng* = 324 to 486 threads). The *tzu-tshui* with hemmed borders was worn for one year, for five months or for three months.
3. When mourning for brothers and sisters the *ta-kung*[s] made of seven to nine *sheng* cloth—11 to 15 warp-threads per cm—was worn for nine months.
4. When mourning for uncles and aunts the *hsiao-kung*[6] made of 10 to 12 *sheng* cloth—16 to 19 warp-threads per cm—was worn for five months.
5. When mourning for distant relatives in line of descent or ascent *ssu-ma*[7] with seven *sheng* cloth instead of fifteen *sheng* cloth—which means 11 warp-threads per cm—was worn for three months.

After the mourning period, the hempen clothes were put away and cloth made from the bean-creeper was worn *(chhii tnafu ko*[s]*).*[b] A son began at the head to put off his mourning, a woman with her girdle which is explained thus:°

A man considers the head most important, a woman the waist *(nan-tzu chung shou, fu-jen chung tai*[9]*).*

To remind people to keep to the tradition and to prevent then/from becoming effeminate, Hsien-Tzu said:[d]

Wearing the mourning robe of coarse cloth of the bean-creeper *(hsi-tshui*[10]) and the lower garment of fine textured cloth *(sui-shang*[11]*)* is not the custom of the antiquity.

These few remarks and quotations may suffice to give an impression of the economic and cultural importance of bast fibres used in the manufacture of textiles in Chou China. Now we can turn to the plants themselves and to the methods of obtaining and processing the fibres.

*** *Chit* is very often understood to be the female plant of the nettle plant *{Boehmeria nivea),* see Giles (i), no. 2977, but here it clearly has to be interpreted as *chii-ma,* the female hemp plant.**

[b] *Li Chi,* ch. 10, p. 12 a. **° *Ibid.,* ch. 10, p. 12 b.**

" *Ibid.,* ch. *2,* p. 30b.

[1] 斬衰 [2] 苴 [3] 齊衰 [4] 枲
[5] 大功 [6] 小功 [7] 緦麻 [8] 去麻服葛
[9] 男子重首、婦人重帶 [10] 絺衰 [11] 總裳

(1) HEMP *(CANNABIS SATIVA* L.)

Hemp *(ta-ma',* also called Chinese hemp, *Han-ma*)* belongs to the family of the *Moraceae* and was grown, as we have seen, to provide textile fibres, to obtain oil from its seeds and to give a psychotomimetic drug (Fig. 4). Most likely the plant originated somewhere in the temperate regions of Central Asia. Francesca Bray has already mentioned* that in i960 a site belonging to the Chhi-chia[3] culture was excavated in Yung-ching county, Kansu province.[b] Among the remains were fragments with the characteristics of coarse hempen cloth adhering to the interior of the jar. The site has been dated between —2150 to —1780. In Chekiang province, fragments have been excavated*[3] at the neolithic site of Chhien-shan-yang.[4] The earliest surviving fragment to be clearly identified as hemp cloth dates from the Western Chou.[d]

The plant is a direct descendant of an outbred wild ancestor, which does not seem to have survived. It is an annual herb, basically dioecious and wind-pollinated. It attains a height of 1.50 to 8 m or even higher, but 1.50 to 4 m may be regarded as average. *Ta-ma* is the general name for hemp in China; the term is applied to both male and female plants. The male plants *(hsi*[s]*)* mature two to three weeks earlier than the female plants *(chii*[b]*).* The male plants have fewer but finer fibres than the female." Male fibres are used for thread; the less readily worked female fibres are suitable for rope.

The planting of hemp, how is it done? You make east-west and north-south furrows on the acre.[1]

To give a general idea of how the Chinese peasant planted and processed hemp, we will summarise the description supplied by Wilhelm Wagner.[8] In 19th-century north China, hemp was grown in small fields in the valleys; the quantity sufficed for the peasants' own needs. The plant did not demand high temperatures to germinate (1-2[0] C), and could be sown in March and April, as well as in summer. The harvest took place three months later when the plants started flowering. Other crops usually followed the hemp in the fields, such as soya beans, kaoliang and sweet potatoes. The density of the plants when sown depended on whether hemp was for spinning or for making ropes. When harvesting, the

» Bray (i), p. 533, n. 3.
[b] Anon. *(539),* pi. 6:1.
[0] Wang Chi-Ying, Mou Yung-Khang (i), pp. 353-8. Anon. *{757),* pi. 10:3-8.
[d] Ko Chin *(1),* pp. 5-7. Li Hui-Lin (6), p. 440.
[e] For more information, see: Bray (1), pp. 532-3; Burkill (1), p. 437; Kirby (i), pp. 46-61 ; Simmonds (2); Bretschneider (1), vol. 2, pp. 203-7, no. 388; Schaefer (1), pp. 1779-88; Vavilov (2), p. 26: Vavilov even considers north China as the possible original home of hemp, see also Ho Ping-Ti (5), p. 81 ; Castellini (1), pp. 2-22; Schuhes (2) ; Joyce and Curry (1), pp. 11-38; Li Hui-Lin (7), pp. 293-301 ; Li Hui-Lin (6), pp. 437-48; Chang (6), p. 21; Simmonds (1), pp. 203-4; Anon. *{644),* PP- 33~8; Wang Yü-Chung, Phei Chin-Chhang (/), pp. 656-61; Anon. *{531),* pp. 57-8, 268, 301-3; Sung Chan-Chhing (/), pp. 48-57; Chhen Hsi-Chhen (/). Many of the aspects are already dealt with in *CCMF* of 1901.
' Karlgren (14), p. 66, no. 101:3.
* Wagner (1), p. 359.

[1] 大麻 [2] 漢麻 [3] 齊家 [4] 錢山漾 [5] 枲 [6] 苴

Chinese pulled out the whole plant; the leaves, roots and tops were then chopped off. To separate the textile fibres, the peasants soaked the stems in water for 12 to 24 hours; after this they heaped up the stems and covered them with matting to ferment. After about one day, the raw fibres (including the cortex) were peeled from the stem and underwent a cooking process in water and alkaline ashes. During this process bark particles were removed from the fibres mechanically. Fibre preparation was completed by drying the material.[8.]

Discussion of hemp processing as understood by a westerner, should not be concluded without reference to the impressive series of 120 sketches of hemp cultivation and processing described by Natalis Rondot.[b] Rondot translated the titles of the sketches and added short explanations, but the sketches themselves, not reproduced in his article, were made by Kuan Thing-Kao[1], an artist active in the first half of the 19th century in Canton. The captions describing the various steps, especially those of sketches nos. 28-76, clearly indicate how hemp was processed in south China and confirm the methods mentioned by Wang Chen in his treatise of + 1313. A scroll by Liu Sung-Nien[2] *(c.* + 1150, died after + 1225) provides pictorial evidence of the processing of hemp (Fig. 1).°

The titles and explanations (corrected by us) follow:

nos. 28, 29 Pulling up the stems according to size; the large grown stems are preferred *shou ta tsao ma*[3] (Fig. 2);

no. 30 Sorting out the large and the small stems *chien khai ta hsiao mashu**;

no. 31 Binding the stems in bundles *cha chheng pa*[s]*;*

no. 32 Soaking the stems in a pool of water *chiang ma chin shui*[6]*;*

no. 33 Sinking the stems with stones to the bottom *shih tse ma shui ti*[7] (Fig. 1);

no. 34 Taking the stems out of the water after having been soaked for two nights *ma chin shui Hang y eh chhi hui*[9]*;*

nos. 35, 36 Scraping off the leaves and twigs, performed by women and children *ko ma chih*[9]*, chia mayeh*[10]*;*

no. 37 Cutting off the roots *chan ma shu thou*[11]*;*

no. 38 Peeling the skin from the stem *po ma phi chhu ma ku*[12]*;* the workman is shown seated on a long bench, to one end of which is fixed an erect pin. With his fingers he prises the skin from the tip of the stem. He then brings the stem up against the pin with his left hand and holding

[a] **A good description of the stripping can be found in Schaefer (I), pp. 1784-5. It is based on Hager (1).**

*** The article is not signed by an author but should be attributed to Rondot (7), pp. 209-23. Without doubt the manufacture of hemp is described, not that of ramie as might be supposed. A supplementary article by the same author (5), pp. 209-16.**

[c] **National Palace Museum, Taiwan (VA 35 c). It is highly probable that the processing of hemp is what is depicted here.**

[1] 關廷高 [2] 劉松年 [3] 收大造麻 [4] 揀開大小麻樹
[5] 扎成把 [6] 將麻浸水 [7] 石責麻水底 [8] 麻浸水兩夜起回
[9] 隔麻枝 [10] 夾麻葉 [11] 斬麻樹頭 [12] 剝麻皮出麻骨



Fig. 2. Pulling up the stems (*chhi ma-shu*), 19th century; Industrie du ma, 19th century. Bibliothèque Nationale, Paris (Oe 92, pl. 5).

it firmly, takes hold of the loosened end of skin with his right hand and peels it off, leaving the denuded stem to fall to the ground;

no. 39 Scraping the skin *kua ma phi*[1]*;* (Fig. 3);

no. 40 Wiping the skin dry *mo ma chfian*[2]^

no. 41 Arranging the skin into large bundles *li ta kui;*

nos. 42, 43 Soaking the fibre material for one night *chin iyeh chhi ma*;*

no. 44 Washing the hemp *hsi ching ma*[s] *;*

nos. 45, 46 Drying the hemp in the sun *shai ma*[6], turning and drying the hemp a second day *tsaijihfan chuan ma shai*[1]*;*

no. 47 Sorting out the white and coloured hemp *chien pai chhih ma» ;*

no. 48 Sorting out the long from the short hemp *chien khai chhang tuan ma*[9]*;*

no. 49 Dividing the hemp fibres into handfuls of one *chin* weight/«« *mei shou ma i chin*[10] *;*

no. 50 Watering *wei shui hua*[11]*;* a purely Chinese process in which water is blown from the mouth so as to moisten the hemp fibres;

[1] 刮麻皮 [2] 抹麻粉 [3] 理大古 [4] 浸一夜起麻
[5] 洗淨麻 [6] 曬麻 [7] 再日反轉麻曬 [8] 揀白赤麻
[9] 揀開長短麻 [10] 分每手麻一斤 [11] 微水花



Fig. 3. Scraping the skin (*pien-khai ma-ku*), 19th century; Industrie du ma, 19th century. Bibliothèque Nationale, Paris (Oe 92, pl. 6).

no. 51 Beating the hemp *chhui ma';*

no. 52 Hatcheling with hatchels (combs) fastened to a bench *shuo ma eking*[2] *;* the labourer takes one handful and draws it rapidly through them;

nos. 53, 54 Collecting and drying *chih ma ssu ken*[3]*, tsai shai Ran ma*; '*

nos. 55, 56 Splitting the hemp *ssu khai ma shou*[5] and tying up the shreds *cha ma tzu*[b]*;*

nos. 57, 58 Folding the hemp *chieh ma*[1], making a little bundle and binding the small bundles into big ones *cha ta ku ma? ;*

nos. 59-61 Selling the hemp at the market;

no. 62 Beating the hemp a second time *tsai ta san ma*[9]*;*

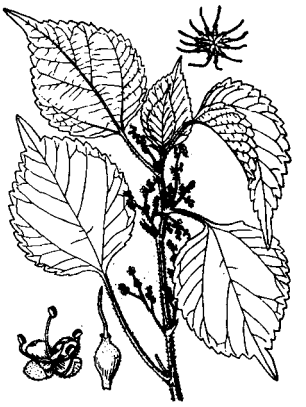
no. 63 Opening the hemp fibres with the teeth*yao san ma thou*[10] *;* biting open the parts which are not yet sufficiently softened;

nos. 64, 65 Smoothing the hemp with the mouth *la li ma khou"* and combing the

[1] 鋪麻 [2] 擲麻頸 [3] 執麻絲根 [4] 再曬幹麻
[5] 司開麻首 [6] 扎麻子 [7] 接麻 [8] 扎大古麻
[9] 再打散麻 [10] 咬散麻頭 [11] 理麻口



1005



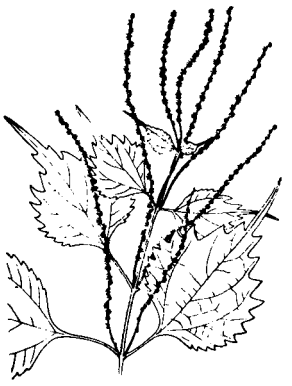
1034



1035



1037



1039



1040

Fig. 4. Bast fibre plants. Anon. (109), vol. I; 1005, *ta-ma*[1], *Cannabis sativa* L.; 1034, *chu-ma*[2], *Boehmeria nivea* (L.) Gaudich; 1035, *chhang-yeh chu-ma*[3], *Boehmeria macrophylla* D. Don; 1037, *hsüan-ling mu-yeh chu-ma*[4], *Boehmeria platanifolia* Franch. & Sav.; 1039, *hsi-yeh-ma*[5], *Boehmeria gracilis* C. H. Wright; 1040, *chhih-ma*[6], *Boehmeria tricuspis* Makino.

[1] 大麻 [2] 苧麻 [3] 長叶苧麻 [4] 懸鈴木叶苧麻
[5] 細野麻 [6] 赤麻

fibres, effected by hand and fingers without the use of a comb *yung shou shu ma*[1];

no. 66 Splitting the hemp fibres (with the hand) to make fine ones *fen khai ma mei shou*[2];

no. 67 Soaking the fibres in basins, rolled up in small rings or hoops *lo shui 0 chin*[3];

no. 68 Splitting the hemp fibres into small shreds *chihyu ma*;*

no. 69 Forming the threads by uniting and splicing. This completes the spinning process *ho ma po chhang*[5];

no. 70 Winding the threads into balls *chiian chheng maying*[6];

nos. 71-2 The balls are carried to market;

no. 73 Steaming the hemp thread balls on a tray *cheng shu ma ying*[1] over a boiler;

no. 74 Drying the thread balls in the sun *shai maying*;*

no. 75 Sorting out the coarse from the fine thread balls *chien tshu yu ma ying";*

no. 76 Doubling the thread *shuang ho ma*[10].

Thereafter the description continues with the working steps necessary for the weaving of hemp cloth.

After having learned about the sequence of working steps, we turn to the Chinese sources dealing with it. We shall notice that only the important working steps are mentioned, and that apart from the retting (steeping) technique, hemp processing methods have changed but little over the centuries. The *Chhi Min Tao Shu* gives a vivid description :[a]

When sowing hemp, use white hemp seeds. White hemp seeds give male hemp.. . For hemp you need good farmland; do not use land that has fallen into disuse. If the soil is poor, manure it. .. For one *mou* of fertile land use three *sheng* of seed, for poor land two *sheng.* The ten days before summer solstice are best for sowing; the solstice itself comes next, and last come the ten days after the solstice. A proverb says: (Hemp planted) after the summer solstice will not cover a dog, but some people reply : all it needs is rain and it will cover a camel. If the soil is very damp, first soak the hemp seeds so that they can germinate. . .Hemp sprouts within a few days, and you must frighten the birds away constantly. Once the leaves have appeared, hoe the hemp. When the pollen is as grey as ashes, harvest at once. (Whether (the hemp) is cut or pulled up depends on the region. If you harvest before the pollen has turned grey, the skin of the hemp will not have matured properly, and if you let the pollen change without harvesting the hemp it will soon turn black and yellow). It should be tied in small bundles and spread out thinly

[a] Shih Sheng-Han (9), ch. 8, p. 86. We are greatly indebted to Francesca Bray for allowing us to make use of her unpublished translation of the *Chhi Min Yao Shu.* The *CMTS* incorporated material from various sources as from the *Fan Sheng-Chih Shu* (The Treatise of Mr Fan Sheng-Chih), a lost work dated to *c.* — 37 to — 7, the *Ssu Min Tüeh Ling* (Calendar of the Four Classes) of the + 2nd cent, by Tshui Shih. For further details see Shih Sheng-Han (5). This part of the *CM TS* text is also contained in the *NCCS,* ch. 36, pp. 6 b-7 b.

[1] 用手梳麻 [2] 分開麻每手 [3] 落水砵浸 [4] 隻幼麻 [5] 合麻博長
[6] 卷成麻纓 [7] 蒸熟麻纓 [8] 曬麻纓 [9] 揀粗幼麻纓 [10] 雙合麻

(so that it will dry easily) and each night you should be careful to turn it over. If the dew falls on it (and it is not turned over) then the skin will turn yellow. Once the hemp has been cut it must be cleaned. (If it still has leaves it will rot easily.) The water in which it is soaked should be clean, and it must be soaked for the right amount of time. If the water is dirty the hemp will go black; if there is too little of it the hemp will be brittle. If the hemp is soaked too short a time it will be hard to peel and if it is left long enough to rot it will not do for clothes. If you use water from a warm spring that has not been frozen and soak the hemp on a winter's day you will get the softest strongest fibres.

One essential fact that appears here is that the retting always was done in a pool and not in running water. This certainly was because the process gave a by-product: the retting water could be used to exterminate insects and to 'drive worms out of the earth'.[a]

Wang Chen starts his description of the hemp processing with the explanation of the soaking pool *(ou-chhih*[1]*).* A simple illustration depicts a square-shaped pool in which three rows of hemp stems are spread out.[b] He says:[c]

Every village in which hemp is planted and which has no (natural) water place, digs for ground water or lays bricks (for a pool) where water can be stored to be used (later) in the soaking process. . . In every region of the north where hemp is planted, the material is bundled after reaping and placed in a pool. Cold water should be warmed up until suitable; in it the material is processed for a period of time. If the person in charge of surveying (the process) keeps to the rules, then the hemp bast will be soft and white, pliable but strong (and hence a good material) to splice and for producing fine cloth. In the regions of the south the hemp is pulled out by the roots; as soon as it is soaked it is peeled. The hemp strips are yellow, the bast coarse and heavy, not suitable for fine splicing. Although the southern and northern practices differ from each other, nevertheless the northern method in which the reaping is followed by the soaking in water pools should be regarded as the superior method.

The differences between the northern and the southern methods are only of marginal importance; we may assume—but cannot declare it a rule—that in the south hemp was planted in the first place to obtain strong fibres for manufacturing ropes—ramie could be grown to obtain the fibres for fabrics—while in the north better hemp fibre qualities were required for weaving fabrics.

Soaking in water should not only be regarded as the oldest method applied for retting but also as the most known and widespread method. After having gained some experience using this technique, the Chinese may have experimented and found that boiling the material in hot water led to an equally satisfactory result. To obtain hemp fibres as white as ramie fibres bleaching material could be added.[d]

Chinese treatises supply a figure of the productivity rate in terms of raw fibre

* Schaefer (1), pp. 1783-4.

[b] *NS* (+ 1530), ch. 26, p. 2a.

[c] *NS,* ch. 22, p. 2 a.

[d] *Wu Lei Hsiang Kan Chih* (before +1102), ch. 1, p. 7a. *Thiao Hsieh Lei Pien* (before +1240), ch. 2, p. 38; *MLTW,* p. i_{45}.

[1] 漚池

material obtained from hemp: from one *chin (c.* 600 g) of hemp stems, one obtained four *Hang (c.* 150 g) peeled bast which would be processed into fibres.[11]

As soon as the male workers had obtained fibres from the plants, women performed the tasks of splicing, twisting and weaving. In the *Shih Ching* (Book of Odes) we read:[b]

No longer splicing her hemp, she dances in the market place *(pu chi chhi ma shihyeh pho so[1]).*

Dancing may not have been productive but was certainly more amusing than the tiresome work of splicing.

(2) RAMIE *(BOEHMERIA NIVEA* (L.) GAUDIGH)

The three fragments of ramie cloth from Chhien-shan-yang in the north of Chekiang province constitute so far the earliest finds of this fibre material. The site is dated to the —3rd millennium.[0] Ramie *(chu-ma[2])*—the name comes from the Malay *rami*—has been exported from China to Europe as a raw fibre material known by the name China-grass *(Chung-kuo-tshao[3]).* As a fabric it is called summer-cloth *(hsia-pu[4]).* Ramie belongs to the family of the *Urticaceae,* the nettle plants,*[1] and a wide range of *Boehmeria* has been used in Chinese textile production.[6] Two types which are of the greatest economic importance should be distinguished (Fig. 4): *Boehmeria nivea* forma *chinensis* (Gaudich), the white or yellow Chinese ramie *(huang-ma[s])* with leaves which are white and hairy on the underside, and *Boehmeria nivea* forma *indica* (var. *tenacissima* Gaudich), the green ramie *(chhing-ma[6]),* only to be found in the southernmost parts of China such as Kuangtung.[1]

W. Bally has described the plant as follows.[8] Ramie is monoecious, male and female flowers being borne on the same stem. Two panicles each arise from the axils of two leaves, and the flowers are arranged in close clusters on the branches of the panicles. The panicles in the lowest part of the stem bear exclusively male flowers, those at the top female, while intermediate panicles exhibit both male

[a] *NSISTT* of +1314, ch. 1, p. 20a; *Chung Shu Shu* (The Book of Treeplanting) of *c.* +1390 by Yü Chen-Mu, ch. 1, p. 56b; *CFP,* book 10, ch. *chhiian,* pp. I3a-i4b.

["] Karlgren (14), p. 88, no. 137; we replaced spinning in the translation of Karlgren by splicing.

[c] Anon. *(757),* p. 86; pi. 10:3-8.

[d] Bray (1), pp. 535-6. (As a Chinese source the *CCMF* can be recommended.) *GTL,* vol. 2, p. 186; Schilling (1), pp. 50-2; Berger (i), pp. 224-7; Kirby (1), pp. 148-80; G.Franke (1), pp. 354-60; Simmonds (1), p. 323; Wagner (i), p. 356; Willimot (1), pp. 405-8; Bretschneider (1), vol. 2, pp. 210-11, no. 391. It may be of interest to note that in early times the common nettle *(Urtica dioica)* was widely used by the people of northern Europe and Eurasia. Manninen (1), pp. 185, 352. It spins quite well (Hald (1), pp. 28-49) » [a n]d as early as the + 13th century Albertus Magnus compared it with fabrics made of hemp and flax.The earliest finds in Europe are fragments from Voldtofte, Denmark (Koie (1), pp. 98-102).

[e] *CKKTCW,* vol. 1, pp. 517-20.

['] The green ramie is called rhea *(Boehmeria utilis)* in India, esp. Assam; Wiesner (1), vol. 1, pp. 566-74; see also *TKKW,* ch. *shang,* p. 44b.

[»] Bally (3), p. 13. Bally's study is profound and knowledgeable.

[1] 不績其麻市也婆娑 [2] 苧麻 [3] 中國草 [4] 夏布
[5] 黃麻 [6] 青麻

and female flowers. The male flower has four sepals united at the base, four stamens, and a rudimentary ovary. The female flower has an upright, hairy and four-lobed calyx. A long feathery style inclined to one side protrudes from the calyx. The ovary is united to the calyx and has a single locule containing only one ovule.

Boehmeria nivea grows to a height of 1 to 2.50 m, and the raw fibre bast has a length of 40 to 150 cm. The degummed fibre still has a length of up to 60 cm, the average being between 15 and 30 cm depending on the way it was processed. In cross sections the fibre cell has a flattened, rather irregular shape. It possesses a high tensile strength both wet and dry, a high absorbency and suppleness, and has a silky white lustre. It is an ideal cloth fibre for a hot wet climate.

Before referring to the Chinese sources we should like to give a short summary* of the series of tasks involved in the processing of ramie fibres prior to weaving. Such a summary appears to be essential because most Chinese scholars of pre-modern times relied solely on traditional texts transmitted through the centuries. Very often they only copied passages from such texts and did not understand all details of the processing, because most of them had no practical experience of agricultural work.[b]

The stem of the ramie plant consists of three layers : the cortex, the fibre bast layer, and the inner wooden body. The fibres are held together by gums and pectins, therefore, special methods of preparation are required. At harvest, the leaves and small branches are chopped off first. The stems are split lengthwise, and the cortex stripped in ribbons from them. These ribbons comprise cortex, fibrous material and adhesive gums. The Chinese try to remove the cortex and gums before the plant has dried; this slow and tedious process is executed by hand. To sum up, the decortisation takes place in the fields, immediately after the green stems are cut and while they are still moist and soft.

The bast ribbons are soaked in water and then the green outer layer is scraped off. This is done, as Bally[0] reports, by passing the ribbons between a bamboo or iron ring worn on the thumb and a wooden knife held in the hand. Virtually no foreign matter now adheres to the fibre ribbons, which are then hung up to dry. No further processing is needed, the dried ribbons being collected into bundles for sale at the market or for export to Europe as 'China grass'. To be separated into fibres for splicing and twisting (or spinning as is done in the West and as was done to some extent in China in pre-modern times), the China grass must undergo a degumming treatment. Degumming is difficult because the chemicals used in the process, if not thoroughly removed by washing, can easily damage the fibre and decompose the fabric.

In splicing, the fine fibres were connected by hand to form a continuous filament. Such a filament could afterwards be twisted, doubled etc. Hand-spinning was also

[a] *TTD,* p. 155; Bally (3), p. 21 ; *GTL,* vol. 2, pp. 214-15; *EB,* vol. 22, p. 875.
» *MLTW,* pp. 187-260.
° Bally (3), p. 2i.

possible," which helped to produce an even yarn and replaced the twisting process used for single yarn. Chinese hand-spun ramie yarn reached a fineness of Nm 120 (i.e. 120 m of yarn weighs one gram) ; nowadays machine-spun ramie yarn reaches Nm 50.

It will now be worth looking at the Chinese sources and what they tell us about the cultivation and processing of the ramie plant. We have arranged them according to the sequence of working steps executed and in chronological order wherever possible.

In Lu Chi's (+261 to +303) *Mao Shih Tshao Mu Mao Shou Chhung Tit Shu* (Commentary on Botanical and Zoological Terms in the Mao-edition of the *Shih Ching)* we find the following entry:[b]

Ramie *(chu[1])* is also a hemp plant. It can grow several tens of stems in succession and the main root (from which the stems come) is under the ground. In spring the plant grows and it is not necessary to plant it every year. In the regions of Ching-chou [modern Hunan, Hupei and Kueichou] and Yang-chou [modern Kiangsi, Chekiang and Fukien] three harvests can be gathered every year. Nowadays it is planted in official residences. Twice a year it is cut. Once this is done, it grows again. The peeling is executed with an iron or bamboo knife. When the external bark has been scraped off, the thick skin (holding the fibres) can be removed and one obtains the pliable but strong material which is like sinews. One boils it before use can be made of it in the splicing *(chhi[2])* process. Thereafter it is called the excellent ramie.

From the paragraph *Hsia-pu[3]* (Summercloth) in Sung Ying-Hsing's *Thien Kung Khai Wu* of + 1637 we may add:[c]

There are two methods of planting (ramie), either sowing the seeds or (planting) root cuttings.

Two methods of ramie processing were commonly applied: one dry and the other wet. Wang Chen describes the dry-processing method used in Yuan times;[d] but starts it with a quotation from the *Shih Ching* (Book of Odes) :

In the moat by the eastern gate, one can soak the ramie *(ou chu[4]).*

He continues:

We know that ramie can be processed by soaking.[e] When asked, the manufacturers of ramie in the south say that ramie fibres are innately difficult to soften; ramie must be softened otherwise than by the soaking (method applied to) hemp (in the north). Before the spinning of the yarn can be perfected, the fibres need to be spliced *(chi[5]).* After this dry lime *(kan shih hui[6])* is sprinkled in amongst the yarn (and left) for several days - in summer three days, in winter five days, in spring and autumn in between. (After this procedure) it is already finished. (The lime) has only to be shaken off.

[a] Nevermann (i), p. 53.
[b] The work is contained in the *TSCC,* vol. 1346, ch. 1, p. 18.
[c] *TKKW,* ch. *shang,* p. 44b. * JVS, ch. 22, p. 2b.
[e] The wet-processing method is described below.

[1] 紵 [2] 緝 [3] 夏布 [4] 漚紵 [5] 績 [6] 乾石灰

A wet-processing method, for bleaching as well as degumming, is reported from the *Shih Nung Pi Tung* (The Farmers' Essentials), a lost work from the + 12th or + I3th centuries:*

Do not use lime in the boiling process. Wait until the water is cold (after having boiled the material), then rinse it in fresh water. After that rush matting is evenly spread on the surface of the water. On the matting the ramie threads are distributed (in such a way as to be) half soaked in the water and half dried by the sun. When night comes they are collected and taken out to drip dry. The next day the procedure is repeated (and so on) until the threads are extremely white. Only then can one start (to manufacture) cloth. This is the way the soaking of ramie is done.

The *Thien Kung Khai Wu* supplies further information describing the wet-processing method as it was applied in Ming times:[b]

After being peeled from the (woody portion) of the stem, the tissues of ramie fibres are stacked to dry in the sun, as they will rot if exposed to moisture. In order to separate the individual fibres (through the removal of gum), the dried fibres are steeped in water, but the length of steeping is not to exceed twenty quarters in time (equal to ten hours), as prolonged soaking without separation will also cause rot. The natural colour of ramie fibres is light yellow, but it is bleached into pure white. (The fibres are first boiled in an aqueous solution containing the ash of rice stalks and lime, then repeatedly rinsed in flowing water, and finally dried in the sun until the pure white colour is achieved.)

An excellent passage on the processing of ramie can be found in the *Nung Sang Chi Tao* (Compilation on Agriculture and Sericulture) from + 1273. It is quoted in several works and the textual variations are negligible.[6] According to the Chinese tradition of transmitting texts down the centuries, we may assume that the original passage was composed before Yuan times. Most probably it should be seen in the context of intellectual interest in agricultural affairs of the + 11 th and + 12th centuries. The translation below is based on the text of the *Nung Sang Chi Tao:*[a]

When harvesting ramie one uses either bamboo knives or iron knives. From the tip of the plant (the skin) is separated (from the stem), using the hands for stripping down the skin *(phi*[1]*).* Then the white core *(pai jang*[2]*)* is scraped with a scraping knife; the leftovers of coarse skin come off quite naturally in this way. Bound in small bundles (the ramie fibres) are suspended from the roof of the house, (being thus exposed) to the damp of the night and the sun of the daytime. Such (treatment continued) for five to seven days makes the ramie naturally white and pure. After that one takes the bundles down.

» *MLTW,* p. 224, no. 254; Wang Yü-Chung, Phei Chin-Chhang (7), p. 569.

[b] Sun (1), p. 64.

[c] *NSCY,* ch. 2, pp. iob-ua; *NS,* ch. 10, pp. ioa-iib; *NCCS,* ch. 36, pp. 4b~5a.

<• See n. a; it should be noted that the paragraph in the *NSCY* has the title *chu-ma* (ramie); *ma* (hemp) is a separate paragraph. In the *NS* we find the caption *chu-ma* but from the text it is not obvious whether ramie or hemp is meant, because the author in one place used *ta-ma* which means hemp. In the *NCCS* the whole case is even more complicated. Hsü Kuang-Chhi quotes this paragraph under the caption *chhing-ma*[3]*;* another name for *cbhiung-ma** or *meng-ma}* 'Chinese jute'. There is no doubt that the description of the bast fibre processing deals with ramie and no other bast fibre plant, especially for technical reasons; see for technological details also, Wang Yü-Chung, Phei Chin-Chhang *(1),* pp. 658-9.

[1] 皮 [2] 白瓤 [3] 綠麻 [4] 苘麻 [5] 蔴麻

Assuming there is rainy weather then (it is best) to hang (the bundles) in the draughty parts of the house for drying. One should be aware that constant rain is the reason why ramie becomes black; it becomes soaked. That is the way in which ramie is peeled.

The ramie fibres are spliced *(chi[1])* in the warm periods of spring, summer and autumn in the ways traditionally practised in each region. In winter times warm water (is used) to moisten (the material) so as to get it easy to separate *(fen-po[z])* (and to work). (In case the material) is dry, hard and difficult to separate, one winds it (in the shape) of hanks *(ying-tzu[3])* (or balls) after having completed its splicing, and steeps it in jars filled with water for one night. Having completed the spinning *(fang[4])* on the spindle-wheel one soaks (the yarn) for one night in water enriched with mulberry brushwood ashes *(sang-chai-hui[s])*. Afterwards one takes them out. For every five *Hang* (186.5 g) °f ramie yarn *(lu[6]),*[3,] one wine cup of fine lime *(hsi-shih-hup)* is thoroughly mixed with water;[0] it is (then) put into a vessel where it rests for one night. The next day the lime water is poured out and instead (the material) is soaked in water enriched with panicled millet cornstraw ashes *(shu-chiek-hui[s])*. After soaking and boiling (the fibres) are naturally white and soft. After being dried in the sun (the fibres) are boiled once more in clear water. Do not use water if it is not absolutely clean. (After this they) are (again) dried in the sun, (and the work) is completed. The ramie yarns are arranged as warp and weft for the weaving process in the ways which are traditionally practised in every region.

The processing of ramie fibres evidently needed a lot more practical experience than the working of hemp. Various sorts of ashes and lime were in use, especially for the task of degumming. It was probably in Chou times that people first added lime and alkaline ashes during the boiling process. This innovation must be seen in connection with the degumming process in the silk industry, where clam-shells burnt to lime *(shen-hui[9])* must have been already employed to degum silk. So the Chinese had gained some experience with lime over the centuries and knew how to apply it. In Yuan times a mixed processing method to free the material from the gum *(tho-chiao[10])* came into use. It is described as a steaming method with hot vapour *(hsiin-cheng")* where the water was enriched with sulphur *(liu-huang[12])* to bleach the fibre.[0] Regrettably, the sources available to us provide no further information about the details of the technology and its origins. But there can be no doubt that the simplest method of retting was the one in longest and most general use; all the other methods should be considered as having been of marginal importance only.

The anonymous Chinese author of the *Nung Sang Chi Yao* clearly states that

[a] The ramie yarns are called *lu,* the shape in which they are wound *ying-tzu;* see *NCCSCC,* **vol.** 2, **p. 1013, n. 23.**

» *NCCSCC,* p. 1013, n. 23 says that the wine cup has to be regarded as the measure **for the quantity** of lime.

[c] Anon. *(644),* pp. 33-8; Wang Yü-Chung, Phei Chin-Chhang (1), pp. 658-9. The **quotations in both** research works are taken from the *Ko Wu Tshu Than* (Simple Discourses on the Investigation of Affairs and Things), ch. *hsia,* p. 7a (p. 4445 in the *Hsüeh Hai Lei Pien* ed., vol. 8). This method was also **applied** when bleaching fabrics made of the *ko* plant. *Wu Lei Hsiang Kan Chich* (bef. + 1102), ch. 1, p. 7a.

[1] 績 [2] 分擘 [3] 纓子 [4] 紡 [5] 桑柴灰
[6] 纑 [7] 細石灰 [8] 黍稭灰 [9] 蜃灰 [10] 脫胶
[11] 熏蒸 [12] 硫黃



Fig. 5. Splicing bast fibres, Li 黎 minority, Kuangtung province, 20th century. Anon. (*701*), p. 19.

splicing and spinning are two separate tasks. Splicing techniques are applied to obtain a continuous yarn suitable for spinning, which means, in practical terms, twisting it into an even spiral structure throughout its length. That the spliced yarn could be used in weaving without being spun may be seen from a short sentence in the *JVung Shu* (Book on Agriculture) of + 1149 by Chhen Fu:[a]

Splicing (the fibres) to make cloth of them *[chhi chi i wei pu*[1]*).*

Usually women performed the splicing of bast fibres into yarn by making use of natural properties of the fibres, namely the gums and pectins. We can see this as it is pictured in a photograph depicting two women of the *Li*[2] minority in China, one splicing bast fibre yarn, the other spinning the yarn with a hand-spindle (Fig. 5). In Japan this technique of producing a continuous bast fibre yarn was also employed (Figs. 7, 8). Another fibre which had also to be spliced is the banana fibre. We see this performed by a woman on Okinawa (Fig. 6).

We turn now to the productivity of the ramie plant. Chhen Fu states that three to four crops can be harvested in one year.[b] Other sources agree on three crops a year harvested in the fifth, in the middle between the sixth and the seventh

[a] *Nung Shu* of + 1149, ch. 1, p. 6b.

[b] *Nung Shu* of + 1149, ch. 3, p. 5a.

[1] 緝績以爲布 [2] 黎



Fig. 6. Splicing banana fibres, Okinawa, 20th century. Yanagi Sōetsu (*1*), vol. 3, fig. 263.

month, and in the eighth month,[8,] or in the fifth, seventh and eighth month,[b] or in the sixth, seventh and eighth month." Obviously the month for the harvest depended on the region and the weather. The *JVung Cheng Chhiian Shu* confirms that ramie was cut three times a year and explains:[4]

Each mou of land [one mou is *c.* 600 m^2] yields thirty *chin* [17.91 kg] fibres. It yields not less than twenty *chin [c.* 12 kg]. At present in the area of Chhen and Tshai [in Chou times kingdoms in Honan province] every *chin* is worth 300 coins in money and has exceeded several times (the price) for common cloth.

Wang Hsiang-Chin informs us[e] that the ramie fibres of the first harvest are coarse and strong, fit for coarse cloth. The fibres of the second harvest are slightly softer and finer in quality. Only the fibres of the third harvest are excellent and fit for fine cloth.

From one *chin (c.* 600 g) of ramie bast an expert spinner splices one *chin* of yarn.' From other sources we learn[8] that

• *MISTY of* + 1314, ch. i, p. 15b; *MLTW*, p. 231.

[b] *Shu Yuan Tsa Chi* of + 1494, ch. 14, p. 161.

[c] *Chhiin Fang Phu* of +1621, book 10, ch. *chhiian[1]*, p. 13b; *Yikh Ling Thung Khao* of +1589 (rare books of the National Library, Peking, 1262, microfilm A 546, Cambridge University Library), ch. 8, p. 12a; ch. 10, p. 9a, p. 11b. It cannot be definitely determined whether ramie is meant or another bast fibre.

[a] *NCCS*, ch. 36, p. 5b.

[e] *CFP*, book 10, *chhiian[1]*, p. 13b.

' *NSCT*, ch. 2, p. 11 a. This is technically impossible. Hence ramie bark must be understood as ramie bast.

[8] *Chih Wu Ming Shih Thu Khao Chhang Pien* (An Illustrated Collection of Materials from Various Sources on the Names and Reality of Plants) of + 1870 by Wu Chhi-Chün (repr. Shanghai, 1959), p. 524. In the *TKKW*, ch. *shang*, p. 45a, four to five *Hang* per day are given.

' 全



Fig. 7.



Fig. 8.

Fig. 7. Splicing bast fibres, Kyōto, + 1723. *Hyakunin Jorō,* + 1723.
Fig. 8. Splicing bast fibres drawn from an erect pin: *chōnin chūbon no tsuma* (wife of a middle class citizen), Kyōto, + 1723. *Hyakunin Jorō,* + 1723.

an energetic worker can splice three to four *Hang* (of fibre material) in one working day *[c.* 112 to 150 g]. Even a clumsy worker can splice two *Hang [c.* 75 g] or slightly more.

An expert in twisting ramie yarn uses a treadle-operated wheel. One female labourer produces on it an amount (of twisted yarn) equally to that (produced) by three hand-spinners.*

On a treadle-operated multiple spindle-wheel *c.* 500 to 1.500 g could be twisted in one working day depending on the quality required.[1]*

As to the products made of ramie:

The loom for weaving ramie is the same as for weaving cotton.[0]

... (from the) spliced yarn summer garments, underwear, curtains and mosquito nets are manufactured. When several ramie yarns are twisted together *(chiu-ho[1]),* the yarn (that results) has excellent qualities. It is used in sewing cloth garments and leather shoes.[d]

What of the quality of the fabrics?

[a] *TKKW,* ch. *shang,* pp. 440-453.
[c] *TKKW,* ch. *shang,* p. 45a.
» *FCSH,* p. 77.
[A] *Ibid.*

[1] 糾合

From one *chin* of fine material one roll of ramie cloth can be woven; the next (quality of cloth) needs one and a half *chin* for one roll *[c.* 900 g] and thereafter two to three *chin* for one roll are used. Because ramie fabrics are pliable, strong, clean and white they fetch a price double or more that of ordinary fabrics."

When a weaver has completed a full length of cloth on the loom, a long roll of cloth is about ten and more *chang [c.* 31 to 32 m] long, a short one still above ten *chang.* A cloth with a length of one *chang* woven of four to five *Hang [c.* 150-187 g] (of ramie material) is the finest quality. Thereafter follows the quality of six to seven *Hang \c.* 224-261 g], then eight to nine *Hang \c.* 299-336 g], and thereafter the coarse qualities.[b]

In 19th century China, at least in parts of Kuangtung province, one roll of ramie cloth measured ten *chang {c.* 32 m). If it was woven into a coarse structure (with coarse threads) its price amounted to more than one ounce of silver. If the quality produced was the fine summercloth called *chhing-sha-pu*[1], then the Chinese fixed its price according to the coarseness and fineness of the material. It varied between four and ten ounces of silver for one roll."

A very instructive description of a ramie fabric's quality is available in the *Ling Wai Tai Ta* (Instead of Replies to Friends and Acquaintances about the South-western Regions beyond the Mountain Passes) of + 1178 by Chou Chhii-Fei:[d]

Along the Yu-river and the Tso-river in Yung prefecture ramie is grown." The fibres are pure, white, fine, thin and long. The natives select the fibres which are fine and long to manufacture their *shu-tzu*[2], ramie cloth. They wear it on hot summer days because it is light and cool and absorbs perspiration. . . There are patterned fabrics. When manufacturing one roll of patterned ramie cloth which has a length of four *chang* and a weight of just a few tenths of an ounce (it is possible) to roll the fabric and to put it into a small bamboo tube and still have empty space left in it. . . If dyed with real red, it takes the colour easily. Its price is no longer moderate ; one roll of the fine quality costs ten and more strings.

Sung Ying-Hsing has told us earlier, that the loom for weaving ramie was the same as for weaving cotton. This certainly was the case in all the more developed regions of China, especially in the Kiangsu area. But we know from the *Ling Wai Tai Ta* that the backstrap loom *(yao-chi*[3]*)* was employed in the southernmost regions to weave ramie cloth. There is no contradiction in these statements. They confirm that in Kuangsi, Kuangtung and Yunnan provinces traditional technology was employed unaltered, whereas in the Yangtze river regions this technology developed through several further stages.

» *NSCr,* ch. 2, p. 11 a.

[b] *Chih Wu Ming Shih Thu Khao Chhang Pien,* p. 524.

[c] *Hsii-Wen-Hsien Shih Teh Thiao Chha Kai Lüeh* (A General Account of an Investigation in the Industries of Hsü-wen District) of 1904 by Ho Ping-Hsiu, paragraph *'hsia-pu* (Summercloth)'.

[a] Netolitzky has translated and annotated the work, see Netolitzky (1), p. 108, Abschn. 6.25; *MLTW,* p. 210, no. 222.

[e] The *Tu* ('right') River and the *Tso* ('left') River are the sources of the *Tung* River, also called *Tit* River.

[1] 青紗布 [2] 綀子 [3] 腰機

(3) *PUERARIA THUNBERGIANA* (SlEB. & ZUCC.) BENTH.

The bean-creeper or vine-creeper *ko*[1]—or *kuzu* vine as the plant is called in Japan[a]—which belongs to the *Fabaceae,* should be regarded as a plant native to East Asia. Archaeological finds from Tshao-hsieh-shan[2] in Kiangsu province,[b] which may be dated to the —4th millennium,[0] indicate that its history as a textile fibre plant in China started earlier than hemp. As is the case with so many plants either gathered or cultivated in early times by the Chinese, the bean-creeper could be exploited in various ways. Not only did it serve for the manufacture of textile fibres, but also excellent arrowroot starch and a sort of flour useful in the preparation of food and fermenting wine could be obtained.[d] Its leaves supplied fodder for the cattle. Furthermore the plant was suitable for making paper.[e]

The bean-creeper[f] had many names in China, such as *huang-chin*[3], *lu-huo** and *chi-chhi*[s]ß The *Nung Cheng Chhiian Shu* (Complete Treatise on Agriculture) distinguished two types of *ko* plant: the wild growing *yeh-sheng*[b] *Pueraria lobata* (Willd.) Ohwi or *Pueraria thunbergiana* (Fig. 9) and the cultivated *Pueraria.* The wild plant grew abundantly in all parts of China on mountainous and waste ground; others like *Pueraria montana* (Lour.) Merr. or *Pueraria thomsonii* (Fig. 9) grew in the south-western part and in the south-eastern coastal provinces of China.

Thé Chinese also distinguished the bean-creeper plants according to their usefulness and processing quality. We hear of one type with fine white hair *{pai hsi mao*[7]*)* which could be spliced and woven into cloth, called *mao-ko*[s]. This description applies to most bean-creepers of the *Pueraria* genus. The other type without hair was called *chhing-ko*[9]. It could not be spliced, but only bound or knotted together *(shu-fu*[!0]*).The* hairy bean-creeper can be divided into two types: one spreading on the grass as it grew, with many branches and many nodes, which made it easy to cut. Cloth made of it, however, is not durable and longlasting.

* The plant is also called *katsu* in Japan.

[b] In the opinion of the Shanghai textile historians (Anon. *{644),* P- 224 (4)) this fragment *of Pueraria thunbergiana* cloth is the earliest textile fragment excavated in China so far: Wu Wen-Hsin *(1),* p. 3; Wu Shan (/), p. 59. The damaged fragment, now in the Nanking Museum, was found in 1972. It is a so-called plain gauze weave where warp and weft interwork 1/1, named in Chinese *Men-tan ti lo-sha".* As far as one can tell from the picture in Anon. *(644), p.* 113', two warp systems have been used, a ground warp *li-ching* '[2] and a doup warp *chiu-ching*[1]^ or *chiao-ching*[4]. The warp-thread density in the gauze weave is about 26-28 threads per cm. For more information, see Anon. (765), p. 4.

[c] Chang (1), p. 551, —3420+110. The site is contemporary with the site of Sung-tse[15], Kiangsu province, *c.* —3400, see Chang (1), pp. 140-1; Chang (6), p. 41.

[d] *CKKTCW,* vol. 2, pp. 501-2; *Thu Ching Pen Tshao,* a lost work of +1061, quoted in the *MLTW,* p. 321, no. 382.

[e] *Ibid.,* p. 502.

' Bretschneider (1), vol. 1, pp. 208-10, no. 390; vol. 3, pp. 308-9, no. 174.

[g] *Thung Chih Liieh* (Comprehensive Treaty) of +1150 by Cheng Chhiao, ch. 51, p. 9b; *NCSS,* ch. 36, p. 8b.

[1] 葛 [2] 草鞋山 [3] 黃斤 [4] 鹿藿 [5] 鷄齊
[6] 野生 [7] 白細毛 [8] 毛葛 [9] 青葛 [10] 束縛
[11] 簡單的羅紗 [12] 里經 [13] 糾經 [14] 絞經 [15] 宋澤

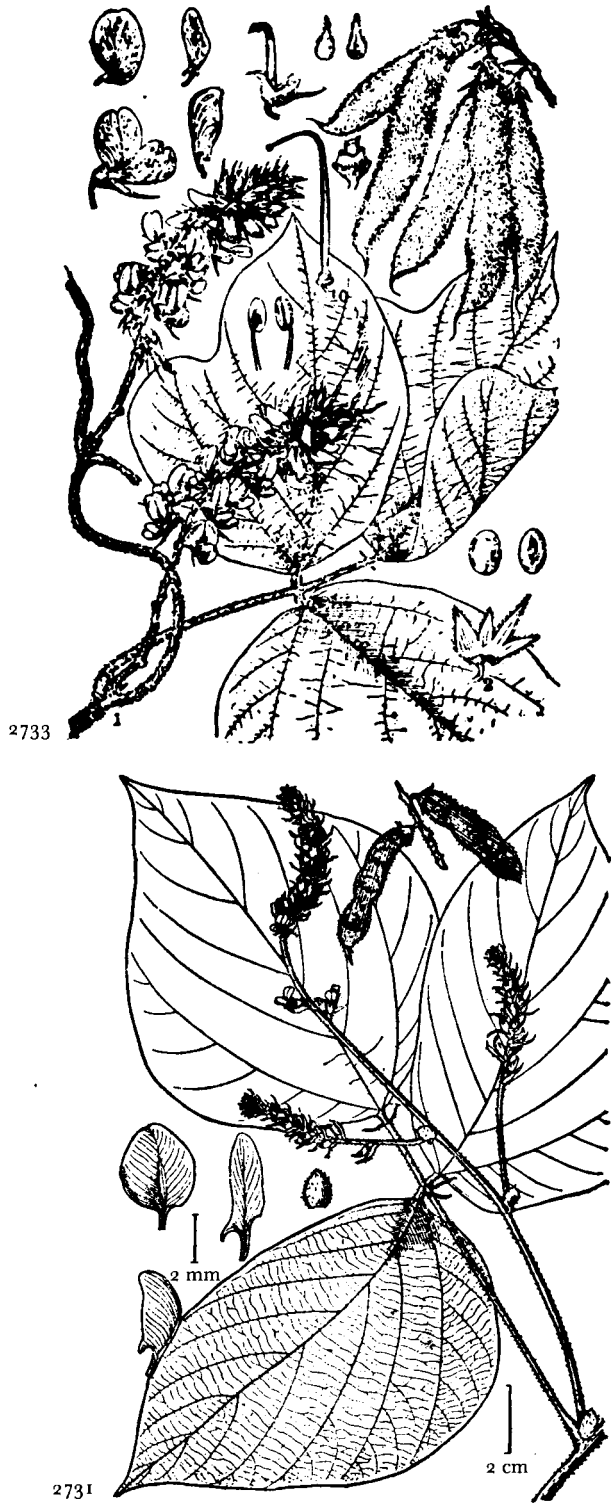


Fig. 9. Bast fibre plants. Anon. (*109*), vol. 2; 2733, *yeh-ko*[1], *Pueraria lobata* (Willd.) Ohwi or *Pueraria thunbergiana* (Sieb. & Zucc.) Benth.; 2731, *yüeh-nan ko-theng*[2], *Pueraria montana* (Lour.) Merr.

[1] 野葛 [2] 越南葛藤

The other type is a climber, growing from the ground. It produces leaves but no branches.*

The stem of the bean-creeper with a length of 5 to 6 *chhih* (150-180 cm) is longer than the stem of ramie as Sung Ying-Hsing had already observed and stated in his *Thien Kung Khai Wu* of + 1637:[b]

The *ko* plant is a creeper and by natural disposition several chhih longer than ramie. It sends out long runners, the leaves having three leaflets, and it flowers in July, producing small beans. It is normally harvested in the 7th and 8th month. When the plant produces a lot of runners, the leaf-stems are proportionately thick and closely spaced and it is not possible to induce branching at the crown by close planting, as it is with hemp. It may have been quite difficult, therefore, to obtain fibres of the best quality. The plant did not require cultivation but even with careful labour the fibres could not, in general, compete with high quality ramie. In consequence, it appears to have gradually fallen into disuse.

From Japan we know that bean-creeper fibres do not bond by contact but must be joined together like banana fibres. In the 20th century bean-creeper yarns are used in fabrics as warp with a cotton weft.

Regrettably, no ancient Chinese record which describes how the yarn was obtained and manufactured, exists as far as we know." All the descriptions available to us are only general descriptions.

Once more the *Shih Ching* (Book of Odes) supplies the earliest information on the bean-creeper textile plant:[d]

How the bean-creeper spreads, it reaches to the middle of the valley; its leaves are luxuriant; the yellow birds go flying, they settle on the thickly-growing trees, they sing in unison.

How the bean-creeper spreads, it reaches to the middle of the valley; its leaves are rich; I cut it, I boil it, I make fine cloth *[chhih)* and coarse cloth *(hsi)*; I shall wear them without growing weary of them.

But not only in the middle of the valley was the bean-creeper found; girls and women went to gather it everywhere.

There I gather the bean-creeper...[e]

The bean-creepers of the backward-sloping hill, how far-stretching are their joints.. .[f]

In the south there are trees with down-curving branches, the bean-creepers and *lei*-creepers cling around them...[g]

[a] *MLTW,* pp. 326-7, no. 396. Unfortunately it is impossible to say anything more definite about the various plants not having gained practical experience with them in China.

» *TKKW,* ch. *shang,* p. 45a.

[c] *Sei Katsu Roku* (Record on the Processing of the Kuzu Vine) of + 1828 by ökura Nagatsune deals with all aspects of the *kuzu* vine, but the textile paragraphs are rather short and not specific.

[a] Karlgren (14), p. 3, no. 2.

[e] Karlgren (14), p. 49, no. 72.

' *Ibid.,* p. 23, no. 37.

[g] *Ibid.,* p. 4, no. 4.

The bean-creepers grow and cover the thorns, the &n-creepers spread to the uncultivated tracts.. .[a]

Maybe a few other species of plants have been included in these poems and were wrongly labelled *ko,* bean-creeper, but generally it would not affect the reliability of the source material. Still, there is further evidence that the bean-creeper fibres were not used exclusively in the manufacture of cloth, but constituted the basic material for the making of shoes and sandals.

Twisted are the strands of the bean-creeper shoes *(chiu chiu ko chit[1]),* with them, one can walk on the hoar frost; delicate are the hands of the women, they can sew a skirt *(khoifeng shang[2]);* they make a bodice; they make a jacket-collar *(chi[3]),* the handsome man wears them.[b]

The bean-creeper shoes were five pairs...[c]

The shoes made of strands from the bean-creeper were presented by the bridegroom when coming in person to fetch his bride. As Karlgren explains, shoes and cap pendants were symbolical marriage presents because they always occurred in pairs.[d]

After gathering, the stems are boiled and afterwards dried. Most probably the fibres received a bleaching treatment as well.

Long-drawn-out are the bean-creepers and the /«'-creepers, on the banks of the river.[e]

Whether drying of stems belongs to the first step of processing after cutting, or is a sort of bleaching after boiling, cannot definitely be decided, but it appears more probable that the description refers to drying after cutting.

The *Ko Wu Tshu Than* (Simple Discourses on the Investigation of Affairs and Things) of Sung times informs us that a few rules for processing the material had to be observed. When washing the finished cloth one used clean, fresh water and a tub made of pottery, not of wood. A wooden tub caused the white colour of the cloth to turn black, though cloth made from the bean-creeper has the property of tending to turn black after a few years anyway. When that happened, it was first washed and afterwards spread out in an open-meshed drying basket. Then sulphur was dusted over it so that it would regain the original bright white colour.'

Let us now move to safer ground. The *Nung Cheng Chhiian Shu* describes the 'method of collecting the bean-creeper' *[tshai ko fa*) :*[g]

In the summer months the bean-creeper is ready for harvesting. Immature and short plants are not collected; only plants with a length of about one *chang [c.* 3 m] are

[a] *Ibid.,* p. 79, no. 124.
[c] *Ibid.,* p. 65, no. 101.
« *Ibid.,* p. 48, no. 71.
" *Ibid.,* p. 69, no. 107.
[a] *Ibid.,* p. 65 commentary.
' *Ko Wu Tshu Than,* ch. *hsia,* p. 7a.
[8] *NCCS,* ch. 36, pp. 8b-9a. The text is based on the *Chhiin Fang Phu* of + 1621 by Wang Hsiang-Chin, book 10, ch. *chhiian* and on the *Tiieh Ling Kuang I* of + 1601 by Feng Ying-Ching (see *MLTW,* p. 332, no. 401) which was not available to us.

[1] 糾糾葛屨 [2] 可以縫裳 [3] 襟 [4] 採葛法

gathered, including the roots. They are called the first *ko.* If the plant is too long, one can see that white spots are near the root (which indicate) that (the plant) is unfit for use. If there are no white spots, one can cut off seven to eight *chhih,* which is called the second *ko.*

Method of working the bean-creeper *{lien ko fa*[1]*).** After having collected the plant fibre material, (some of it is used) to produce fishing nets, (and some) is boiled in hot water over a fire. The fibres are peeled off (from the stems) with the fingernails. The fibres are white as those of the hemp, but do not adhere to the green parts of the plant. Then the peeling is completed. The fibres are rinsed in running water at river banks, beaten with a beater, washed clean and dried in the open air. Exposed to the moisture for one night, they become whiter. Afterwards, they should be put to a shady place to avoid the sunlight. Then they are ready for spinning and weaving.

The bean-creeper plants grew everywhere in Han China; throughout Chinese history it was a plant often referred to as a local product of many regions paid as tribute to the court. From Thang times we get the impression that the plant was manufactured into cloth in Anhui • and Kiangsu,[b] in Tung-yang[2] prefecture in Chekiang,[0] in Chhiian-chou[3] (Fukien province),[4] in Chhang-sha[4] prefecture in Hunan province[6] and in Szechwan province where many prefectures such as Chien-wei[5,f] Lin-chiung[6],» Yang-an[7,h] Nan-chhi[8,1] Pa-chhuanV An-yo[10,k] Nan-phing'^and Lii-chhuan[12,m] are reported. In Sung times we hear of Chi-chou[13n] and Fu-chou[14] ° both in Kiangsi province, as well as of Chhiian-chou[15p] in Kuangsi and Yung-chou[16q] in Hunan. Hence we may conclude that by Chhing times, the coastal provinces, Szechwan, Hunan and Kiangsi already had a well-developed industry for the manufacture of bean-creeper fibres and cloth. The *Nan Tiieh Pi Chi* (Miscellaneous Notes from Kuangtung Made while Travelling) by Li Thiao-Yüan (+ 1734 to + 1803),[1 W n o t o ° k U P an] official post in Kuangtung in + 1774, reports about the *ko* cloth production in Kuangtung province. The report is interesting enough to translate here:[8]

The *ko* of (the provinces) Kuangtung and Kuangsi, especially the 'woman-cloth' *(nii-ko*[17]*)* of Tseng-chheng[18]' is of supreme quality. So it is not sold in the market. Among

[a] The method of working the bean-creeper was already described in the following works: *Tiieh Ling Kuang* /of + 1601, quoted in *MLTW,* p. 332, no. 401 ; *CFP* of + 1621, ch. 10, ch. *Milan.*
[b] *Hsin Thang Shu,* ch. 41, p. 1056.
[0] *Ibid.,* ch. 41, p. 1063.
[a] *Hsin Thang Shu,* ch. 41, p. 1065.
[e] *Ibid.,* ch. 41, p. 1071.
['] *Ibid.,* ch. 42, p. 1081.
[*] *Ibid.,* ch. 42, p. 1082.
[>»] *Ibid.,* ch. 42, p. 1082.
[1] *Ibid.,* ch. 42, p. 1085.
[1] *Ibid.,* ch. 42, p. 1090.
[k] *Ibid.,* ch. 42, p. 1090.
[l] *Ibid.,* ch. 42, p. 1091.
[m] *Ibid.,* ch. 42, p. 1092.
[»] *Sung Shih,* ch. 88, p. 2190.
[0] *Ibid.,* ch. 88, p. 2190.
[P] *Thai-Phing Huan Tit Chi* (of *c.* + 980), p. 90.
[1] *Ibid.,* p. 79.
[f] *EC,* pp. 486-8.
[*] *Nan Tiieh Pi Chi* (composed *c.* + 1777), ch. 5, p. I2a-i6a. *MLTW,* p. 317, no. 377.
[*] Anon. *{640),* pp. 81-2, B4.

[1] 練葛法 [2] 東陽 [3] 泉州 [4] 長沙 [5] 犍爲 [6] 臨邛
[7] 陽安 [8] 南溪 [9] 巴川 [10] 安岳 [11] 南平 [12] 瀘川
[13] 吉州 [14] 撫州 [15] 全州 [16] 永州 [17] 女葛 [18] 增城

the cloth of best quality is some of which daughters can finish only one roll in a whole year. They use it to make the garments for their husbands and that is all. Their weight is three or four *Hang [c.* 112-149 g]. Young girls who have not yet been given in betrothal can weave. Girls already betrothed do not weave. Hence the cloth is called 'girls-cloth' *(nii-erh ko[1]).*

As the north (of China) has its so-called *ku-jung[2]* (woollens made by the maidens), so the south has its *nii-ko[3]*. Two places are famous for their production of excellent *ko* cloth: Chu-ssu-hsi[4] 'brook of the bamboo threads', and Pai-hua-lins 'forest of the white flowers'.

Collecting plants is done by women. It is the job of women. One day's gathering yields only several *Hang* of material. The fine strands of fibres for needlework *(ssu-lü i chen[6])* are (almost) lost in the hand. The material is as fine as the very smallest particle, so that it seems as if it is not there. If one rolls up one *tuan[7]* of cloth *[c.* 5.80 m]» it fits into a pen tube. The ornaments on it are embroidered with silver threads, light and magnificent in style, very much like the wings of a cicada.

When dried in broad daylight, the cloth shrinks, when soaked in water, it shrinks and wrinkles. In both cases the quality of the cloth is rather feeble and cannot be considered as regular quality for garments.

The delicate character of *ko* cloth from Lei-chou[8] alone gains one hundred coins for one foot of cloth. It is fine, shining and durable. Its colour resembles ivory. It is called *chin-nang-ko[9]* 'elegant purse cloth'. It is used for tailoring long gowns with sleeves, fastened at the side. The straight long robe without sleeves (to[10])[b] made of it is called *ta-ya[11]* 'great elegance'. That is the reason why nowadays the *ko* cloth of Lei-chou flourishes under heaven. The people of Lei-chou are expert in weaving *ko* cloth. The production of its *ko* cloth is done in Kao-chou[12], Kao-liang[13], Kang-chou[14], and other districts, and it is woven in Lei-chou into fine cloth *(chhih[l$])* and coarse cloth (A«[16]).

The products of villages and local places have to be distinguished: the types of *ko* cloth produced are not the same... In Kuangtung and Kuangsi there are many qualities of *ko* cloth. That from Lei-chou is the *cheng-ko[11]* 'regular cloth'. The quality produced in Po-lo[18]is called *shan-cheng-ko[l]**>'good government cloth'.. .the quality from Chhao-*ya.ng[20]feng-ko[21]*'phoenix cloth', which uses silk threads for the weft and which is also named *huang-ssu-pu[22]* 'yellow silk cloth'. Qualities from other areas like Chhiung-shan[23], Chheng-mai[24],Lin-kao[2S],Lo-hui[26]are light and fine and hence labelled *mei-jen-ko[27]'* pretty woman cloth'. But none of them equals the *lung-chiang-ko[2%]* 'dragon river cloth' from Kuang-chou[29] which is durable and substantial in quality and which resists all weathers. Generally all these qualities are also known under the name *chhiian-ko[30]*, a very fine fabric...°

[a] It is not possible to determine whether one *tuan* really measures the length of i8 Chinese feet; in accordance with general Chinese custom we may assume so.

[b] Certainly the author did not mean 'to mend, to fix' *to[3t]*, but thought of to[32], a long robe as worn by Taoists.

[e] *Chhiian* is normally regarded as a fine fabric made of ramie, but not of the *ko* plant.

[1] 女兒葛 [2] 姑戝 [3] 女葛 [4] 竹絲溪 [5] 百花林
[6] 絲縷以鍼 [7] 端 [8] 雷州 [9] 錦囊葛 [10] 裮
[11] 大雅 [12] 高州 [13] 高涼 [14] 碉州 [15] 絺
[16] 綌 [17] 正葛 [18] 博羅 [19] 善政葛 [20] 潮陽
[21] 鳳葛 [22] 黃絲布 [23] 瓊山 [24] 澄邁 [25] 臨高
[26] 樂會 [27] 美人葛 [28] 龍江葛 [29] 廣州 [30] 栓葛
[31] 裰 [32] 裮

The women of Lei-chou made a living of *ko* cloth weaving. When manufacturing the *ko* there was no distinction made between fine and coarse yarns. For their needlework women always used yarn spun in a dry spinning technique and not wet spliced. They feared there could be traces left in the yarn.

The (professional) weavers are all from Tung-kuan and their work differs from the work of the common-place ramie weaver. The weaver of *ko* cloth is a craftsman in fine workmanship...

Pure *ko* cloth has no silk in it. If used, silk is taken as weft.

From all the sources mentioned we may conclude that the *ko* bean-creeper supplied a useful and economically profitable textile fibre for weaving cloth of various qualities. In the 19th century and especially in the 20th century the plant lost its importance. People replaced it by cotton and nowadays, of course, by man-made fibres. By now, it has almost disappeared in the field of textile production.

(4) BANANA *(MUSA TEXTILIS* NÉE)

While cloth of the bean-creeper constituted an important item of daily life, fabrics woven of banana fibres always had an exotic touch. However, educated people and scholar-officials might not have thought of banana cloth when whiling away their leisure time in a cultivated atmosphere, in the relaxed company of congenial friends, sitting in the shadow of the large banana leaves rustling by the summer wind (Fig. 10). Philip K. Reynolds and C. Y. Fang have concentrated on the banana plant as a topic in literature.* Here we have to concentrate on the plant's usefulness and importance as a fibre producer.

The leaf sheath of the banana plant *(Musa textilis* Née) *pa-chiao*[lh] contains a highly esteemed fibre material which is commonly known under the name Manila hemp or abaca.[0] The convenient naming may have originated in the commercial banana fibre trade and indicates that the Philippines and Borneo have been important not only as centres of banana fibre production, but also can be considered as the regions where the *Musa textilis* Née originated.*[1]

Generally the fibre-containing *Musa* species do not produce eatable fruits and vice versa.[e] Traditionally there existed a large variety of techniques for obtaining and processing the fibres. As far as China is concerned, information is rather scanty; there are only short descriptions which, from a technological point of view, are hardly satisfactory. They reflect the theoretical knowledge of their authors, but

* Reynolds and Fang (1).

[b] *SWCT,* ch. 1 *hsia,* p. 22a.

« *GTL,* vol. 1, pp. 105-6; Bally (1), pp. 3555-9.

[ä] G. Franke (1), pp. 384-91; Simmonds (1), pp. 211-15; Li Hui-Lin (11), p. 35. Crevost and Lemarié (1917-21) *(Catalogue des Produits de l'Indochine)* consider the species as native of the forests of Annam. Thus, instead of the Philippines, as is generally believed, the actual origin of cultivation of the so-called Manila hemp was most probably on the adjacent Asiatic mainland. This statement is debatable and we leave it to specialists to reach a decision.

[e] Nevermann (1), p. 27.

[1] 芭蕉



Fig. 10. Gathering of friends in the bamboo pavilion by Chhien Ku 錢穀 (+1508 to +1572), +1566. Hanging scroll in the Liaoning-sheng po-wu-kuan, Shenyang.



Fig. 11. Stripping the banana fibre bast layer from the stem, Okinawa, 20th century. Yanagi Sōetsu (*1*), vol. 3, fig. 262.

lack evidence of practical experience. We shall, therefore, present a few short descriptions based on ethnographic materials.

In the 19th and 20th centuries, the fibres were commonly obtained by cutting the stems of the banana plant which could reach a height of 3.5 m and a diameter of *c.* 30 cm. The cut stems were spread on the ground so that the surface skin and the deeper layers would start to decompose rapidly. Thereafter the rotten stems were pounded in running water, after which the fibres could be collected, cleansed, rinsed and hackled or combed. Another method was to cut open the stems in a lengthwise direction to get access to the fibres (Fig. 11).

Elisabeth Krämer-Bannow informs us[£] that banana fibre yarn was prepared by women taking a strip about 3 fingers wide from the stem. They tore it off the stem and put it on a round, barked wooden club which they held with their knees so that it could not move. The right hand pressed a sort of scraper tightly to the round club. This scraper was made from coconut shell, which used to be sharpened with a venus shell along the edge. The left hand held the banana bast and pulled it through between the scraper and club, so that the fleshy parts remained as waste material and the cleaned fibres of the bast appeared snow-white in colour.

' Report in Sarfert (i), vol. I, p. 172.

Thereafter the fibre was twisted between the palm of the hand and the naked thigh. According to Finsch[a] it was possible to ply two fibres into one yarn to get a doubled or two-ply yarn. The fibres needed to be knotted together and the ends of the knots were then cut off with a sharpened shell. In other parts of the Indo-Oceanic world chewing of the fibre material was quite common; thereafter followed the threading and twisting of the fibres into yarn by hand on the thigh.[b] From China we know that it was possible to produce very soft and light fabrics from the fine yarns; the coarse fibres served in the manufacture of rope.[c]

In the Philippihes there were several types of device for separating the fibres; these facilitated the tiresome and tedious work of scraping and made production more economical. As far as we know such machines were not employed in China.

After these few introductory remarks, we must concern ourselves with the banana fibre in Chinese history.[4] We agree with the opinion expressed by Chang Te-Chiin[e] that the weaving of banana cloth has a history in China of at least 2000 years. We do not know how the plant arrived there, but we may assume that it spread from the Philippines to China via Vietnam, Hainan island and Taiwan. Indeed, there is evidence that banana fibre weaving was well established on the islands belonging to China and on the Okinawa islands,[1] where the fabric is called *bashöfu* (Jap. *bashö,* banana). In the *Shuo Wen Chieh Tzu* we already find *pa-chiao* defined as *sheng hsi*[1] 'raw male hemp'.» The *San Fu Huang Thu* (Illustrated Description of the Three Districts in the Capital), composed in the +3rd century and attributed to Miao Chhang-Yen, informs us that in + 111 the emperor Wu had twelve banana plants *Musa paradisiaca* L. *(kan-chiao*[2]*)* planted in his palace *Fu-li-kung*[3] .[h] Because the climate of the north was not suitable, most of the plants soon died. That people in Han times made use of the plant is also supported by the *Kuang-Chou Chi* (Record of Kuang-Chou) by Ku Wei (+ 170 to +250), where we learn that it was cultivated in Kiangsu province.[1]

Tso Ssu[4], a scholar and poet who lived in the Western Chin dynasty (+ 265 to +316) mentions banana cloth in his *Wu-Tu Fu*[5] (Prose-poem on the Capital of Wu (Nanking)) :[j]

» Finsch (i), VIII, p. 217; Finsch (2), p. 435.
[b] Nevermann (1), p. 49. [c] Wagner (1), pp. 361-2.
[d] An excellent study of the banana fibre in Chinese literature and investigating the banana plant as a topic in literature, as well as taking into account various other aspects—for example the banana plant as a supplier of fruits, roots and oil, but not dealing with the plant as a fibre producer—was published by Reynolds and Fang (1), pp. 165-81. [e] Chang Te-Chün (5), pp. 103-16.
' Nevermann (i), p. 29; Rein (1), vol. 2, p. 198; Tonaki *(1).*
« *SWCT,* ch. 1 *hsicfi,* p. 22a.
[h] *San Fu Huang Thu,* ch. 3, p. 8a; see also Chhen Chih (1), p. 75.
[1] *Kuang-Chou Chi* was not available to us, so we refer to Reynolds and Fang (1), p. 168.
[1] *Wen Hsiian,* ch. 5, p. 21 a ; Reynolds and Fang (1) include poems by other poets such as Hsieh Ling-Yün[7] (+ 385½ +433), Pien Ching-Tsung[8] (+ 5th cent), ShenYüeh« (+ 441 to +513); see also the collection of poems in *KCTSCC, (tshao-mu tien),* ch. 185, pp. 827-9.

[1] 生枭 [2] 甘蕉 [3] 扶荔宮 [4] 左思 [5] 吳都賦
[6] 下 [7] 謝靈運 [8] 卞敬宗 [9] 沈約

Banana cloth arose from Kuangtung, it is soft and weak compared with open-work lustrous white silk.

The Chinese distinguished between the banana plant used for textile fibres and that cultivated for fruit production. The *Nan Fang Tshao Mu Chuang* (Appearances of Plants and Trees in the Southern Regions), wrongly ascribed to Chi Han and dated + 304 but really from the Sung period, contains a paragraph[8,] on banana plants. The description is very detailed and of great interest for botanists. The text possibly came from an even older source, the *Nan Fang I Wu Chih* (Record of Strange Things from the Southern Regions) of the second half of the + 3rd century. The *Nan Fang Tshao Mu Chuang* says:[b]

The *pa-chiao*[1] or *pa-chii*[2], the fruits of which are sweet and palatable, the *yang-chiao-chiao** (sheep's horn banana) the fruits of which are the sweetest and most delicious in taste, and the *chiao-ko** (banana linen).

Such works may have served as source for the description of the plant in **the** *Chhiin Fang Phu* (Botanical Treatise) of + 1621 by Wang Hsiang-Chin:°

The 'water-banana' *shui-chiao** has white blossoms but does not bear fruit. The fine material obtained from its stem is collected and boiled in an alkaline enriched water which loosens the fibres like silken threads. They are spliced into fibres and woven into cloth which is called banana cloth. It comes from Kuangtung and Kuangsi province.

In the *Ku Chin Thu Shu Chi Chheng* we also find a short paragraph:[4]

In Fu-chou a local product is the banana. There is the ivory-(coloured) banana, which has a height of about 3.20 m; the fruits are long. The tree of the 'Buddha-finger-banana' *fo-chih-chiao*[6] reaches a height of 160 to 190 cm; the fruits differ a little. The ' beautiful-woman-banana ' *mei-jen-chiao*[1] has blossoms but no fruit. From this type, (the fibres) of the stem can be used to weave cloth.

The *Hui-Lai-Hsien Chih* (Local Gazetteer of Hui-Lai District) of + 1732 tells us,[e] that the yarn from the cloth-banana *(pu-chiao*[s]*)* can be woven into cloth. Its **fruit** is not edible.

From the previously mentioned *Nan Ttieh Pi Chi* we learn that Kuangtung and Kuangsi were also called 'country of the banana'.[1] Many people made the cultivation of banana plants their profession, especially in the valleys. So the audior Li Thiao-Yüan informs us that

* *Nan Fang Tshao Mu Chuang,* ch. *shang,* p. 1 ; Ma Tai-Loi (1) ; Chhen Lien-Chhing *(1).*

[b] *Nan Fang Tshao Mu Chuang,* ch. *shang,* p. 1 ; an excellent translation and commentary was published by Li Hui-Lin (11), pp. 32-3.

[c] The paragraph is quoted in a number of works, as Chang Te-Chiin (3), p. 109; *MLTW,* p. 330. Furthermore the text is reproduced in parts in *Min Chhan Lu I* (Strange Facts Recorded about the Products of Fukien) of + 1886 by Kuo Pai-Tshang; the text was already translated by Reynolds and Fang (1), p. 168.

[d] *KCTSCC, (tshao-mu tien"),* ch. 185, p. 826.

[e] *Hui-Lai-Hsien Chih, (wu-chhan)">,* ch. 4, p. 13b (182).

' *Nan Tiieh Pi Chi,* ch. 14, p. 10a; *MLTW,* p. 320.

[1] 芭蕉 [2] 芭蕉 [3] 羊角蕉 [4] 蕉葛 [5] 水蕉
[6] 佛指蕉 [7] 美人蕉 [8] 布蕉 [9] 草木典 [10] 物產

The soil for the banana plant can be barren with many stones. In that case the fibres will be soft, but strong. If the soil is fertile, then there will be many fruits and fibres of fragile quality only, which cannot be used for cloth-making.

A proverb says :[a]

> Cloth-banana plants are suitable for planting in barren soil;
> fruit bearing banana plants should be planted in fertile soil ;
> fertile soil is suitable for the fruit;
> barren soil is suitable for the fibres.

The famous calligrapher, scholar and official Ou-yang Hsiin (+ 557 to +645) cites various sources about the topic in his famous work *I Wen Lei CM* (A Classified Collection of Literary Productions), compiled in +624.[b] Various methods of processing the fibres are mentioned. Thus we read in the *I Wu Chih* (Record of Strange Things), written in the second half of the + ist century by Yang Fu, a native of Kuangtung province, that the fibre material was boiled. Thereafter it was like silken threads and could be spliced. The women artisans made fine cloth *(chhih[1])* and coarse cloth *(hsi[2])* of it. In his time it was known as 'Annam-cloth' *chiao-chih-ko[3.0]*.

From the *Nan Fang I Wu Chih* (Record of Strange Things from the Southern Regions), probably composed by a person named Wan Chen, we learn of a slightly different method. The author tells us[d] that after the stems had been collected, water was poured over them so as to cause decomposition. Boiling then followed. Thereafter the fibres were like silken threads and could be spliced. When we consider that the south of China was the main production area of banana cloth, it is not surprising to find many names for the plant itself. Thus the *Kuang Chih* (Extensive Records of Remarkable Things) by Kuo I-Kung *(c.* +420 to + 502) remarks :[e]

> The banana plant has several names: *pa-chiao, pa-chii* or *kan-chiao.*. .The cloth is called *chiao-ko.* It is of fragile but good quality, yellowish-white in colour.. .and produced in Annam, Kuangtung and Kuangsi.

During the centuries other names were created, as mentioned above ; these were *chiao-ko*, shui-chiao[5], pu-chiao[b]* and *mei-jen-chiao[1]*. In his *Min Pu Shu* (Commentaries on Fukien), which he composed when living in Fukien province, Wang Shih-Mou (+ 1536 to + 1588),[1] the ideal official and brilliant observer, made a few remarks on the most beautiful of all banana plants, the 'beautiful-woman-banana' *mei-jen-chiao.* He tells us that there were many 'beautiful-woman' banana plants in

[a] *Nan Tiieh Pi Chi,* ch. 14, p. 10b; Chang Te-Chün *(3),* p. no.
[b] *I Wen Lei Chit,* ch. 87, p. 1449; the information is also contained in the *Thai-Phing Tu Lan,* ch. 975, P- 4452-
[c] *I Wu Chih,* pp. 15-16.
[d] *Nan Fang I Wu Chih,* quoted from *NCCS,* ch. 40, p. I2ab.
[e] *Kuang Chih,* ch. *hsia,* pp. gab.
' *MB,* pp. 1406-8.

[1] 絺 [2] 綌 [3] 交阯葛 [4] 蕉葛 [5] 水蕉
[6] 布蕉 [7] 美人蕉

Fu-chou, which do not bear fruit. In Chhiian-chou > and Chang-chou[2] people plant the big banana *ta-chiao*[3] and the small banana*ya-chiao**. Both of them bear fruit. After the fruit has been collected, the stem is chopped to obtain the fibres, which are made into banana cloth.[a]

So far we have heard about the banana plant and the processing of the fibres. Now we turn to banana cloth to learn what Chinese sources tell us about it, and so to get an impression of its economic importance in the south of China.

The Thang official Tu Yu (+ 735 to +812) in his *Thung Tien* (Comprehensive Statutes)—an elaborate treatise on politics, administration, geography and other topics—gives the name of places which produced banana fibre cloth as tribute to the Thang emperor.[b] The cloth came from Chhang-lo[5] district, from Chien-an« district (both in Fukien province), from Hsin-hsing[7] district (Hainan, Kuangtung province) and from Vietnam, which from *c.* +681 to +757 was under the protection of the Thang empire.

The *Yiian-Ho Chiin Hsien Thu Chih* (Topography of the Prefectures and Districts of China in the Reign Period Yüan-ho [+ 806 to +820]) by Li Chi-Fu (+ 748 to + 814) provides us with a list of additional place names where banana cloth was manufactured.[0] In his report, places in the provinces Kuangtung and Kuangsi 'south of the mountain-pass' *Ling-nan*[8] are mentioned.*[1] The *Hsin Thang Shu* confirms that Fukien, Kuangtung and Kuangsi have been the main producing centres of banana cloth in Thang times.[e] A few places produced tribute banana cloth for the imperial court in Sung times. In the *Yuan-Feng Chiu Yii Chih* (Topography of the Nine Regions in the Reign Period Yiian-feng [+ 1078 to + 1085]) of + 1085, we read that patterned banana cloth of a red colour was woven in Chhang-lo district, plain cloth in Chhing-yüan[9] district (Fukien province) and Chhao-yang[10] district (Kuangtung province)/

The *Ta Ming I Thung Chih* (Official Geography of the Ming Empire)[8] of + 1461 by Li Hsien[h] (+ 1408 to +1467) and others[1] list several regions already famous for their banana cloth production. They are all situated in Fukien, Kuangtung and Kuangsi.[3] The *Huan Yü Thung Chih* (Geography and Topography of the Empire) edited by Chhen Hsün (+ 1385 to + 1462),[k]presented in + 1456, served

[a] **Reynolds and Fang (1), p. 170; *Min Pu Shu,* ch. 207, p. 4a.**
[b] *Thung Tien, (shih-huo"),* ch. 6, p. 36; Chang Te-Chün *(3),* pp. 106-7.
[c] ***Tüan-Ho Chun Hsien Thu Chih,* ch. 34, p. 2a; ch. 34, p. 8b; ch. 34, p. 10b; ch. 34, p. 1 ib; ch. 37, p. 4b.**
["] ***Ibid.***
[e] ***Hsin Thang Shu,* ch. 40, p. 1033; ch. 41, pp. 1064-5.**
['] ***Tiian-Feng Chiu Tit Chih,* ch. 9, pp. 400, 404, 418.**
[g] **The work is sometimes referred to as ' *Thien Hsia I Thung Chih* '.**
[11] ***MB,* pp. 819-22.**
[1] Pheng Shih'[2] (+ 1416 to +1475) *{MB,* pp. 1119-20); Lü Yuan'[3] (+1418 to +1462) *{MB,* pp. **1017-20).**
i *Ta Ming I Thung Chih,* ch. 74-84. The list can be enlarged from the *Thu Shu Pien* (Encyclopaedic Compilation) of + 1585 by Chang Huang *{MB,* pp. 83-5). * ***MB,* p. 1019.**

[1] 泉州 [2] 漳州 [3] 大蕉 [4] 芽蕉 [5] 長樂
[6] 建安 [7] 新興 [8] 嶺南 [9] 清源 [10] 潮陽
[11] 食貨 [12] 彭時 [13] 呂原

as model for the *Ta Ming I Thung Chih.* There we find also a short note that people in Kuangsi province used banana plant fibres to make their clothes.[8,]

Li Thiao-Yüan provides us with information on the situation in the second half of the + 18th century. He says:[b]

For the people of Kuangtung the production of banana cloth is rather important. The cloth produced in Kao-yao[1], Pao-chha[2], Kuang-li[3] and other villages is very beautiful. On market days the peasants carry the banana sheathes on their back to sell them... Where silkworms are reared, the silk is only taken as weft in the banana cloth, pure silken fabrics are not produced... Banana fibre cloth and jute cloth *(huang-ma pu*[4])* is of importance for the southern provinces and it is constantly exchanged for winter-cloth.

It may have been quite common to weave a fabric of different material in warp and weft. Such mixtures appear to have been practical results derived from daily life and experience at work. In this way a shortage of raw material could be balanced and the use of warp and weft in different materials could help to strengthen the quality of the fabric so that it lasted longer. On the other hand, there was not enough cotton in Kuangtung and Kuangsi to meet the demand; hence the traditional bast fibre technology has continued until today, as may be seen in jute-banana-fibre mixtures in Kuangtung province.[0] Furthermore, all types of banana cloth could be exchanged for winter-cloth made of cotton, produced in Hunan, Hupei, Kiangsu and Chekiang.

Apart from Gunny Sack Mills, only minorities in south China keep the old tradition of banana fibre cloth manufacture alive.

(5) OTHER FIBRES, INCLUDING A SHORT EXCURSION INTO THE HISTORY OF THE SEED FIBRE PLANT COTTON *(GOSSYPIUM)*

Apart from the bast fibre plants, whose economic, cultural and technical importance has already been shown, a few others, mainly used in the manufacture of ropes and sacks, deserve a mention but not a detailed discussion. They were also used for coarse heavy materials (normally not for robes) and there are several reasons justifying only a brief treatment: firstly, no new or qualitatively different textile processing methods appear; secondly, the plant fibres were mainly used in simple textile techniques such as rope-making, plaiting and mat-weaving but not in real weaving on a loom; thirdly, many of the plants served as raw material in the paper industry to a larger extent than in textile manufacturing.

[8] *Huan Tu Thung Chih,* ch. 110, p. 3a (Nan-ning fu). *Ta Ming I Thung Chih,* ch. 85, p. 10a (Nan-ning fu). (P- 5209.)

f *Man Xiith Pi Chi,* ch. 5, p. 150-16a; *MLTW,* p. 320; Chang Te-Chiin (3), p. no.

[c] State Kuangtung Gunny Sack Mill, Chang Te-Chün *(3),* p. 115.

[1] 高要 [2] 寶查 [3] 廣利 [4] 黃麻布

'Chinese jute', 'China jute' or 'Tientsin jute'[a] *chhiung-ma*[ID] or *meng-ma*[2c] also written *meng*[3] *(Abutilon avicennae* Gaertn., or *Abutilon theophrasti* Medik., Fig. I2)[d] can be found all over China up to an altitude of *c.* iooo m above sea level. It belongs to the plant family of the mallows *{Malvaceae)* like the *Urena lobata* L. *hsiao fan thien hua**,[e] also named *jeh-mien-hua*[s], the *Sida szechuensis* Matsuda *pa-tu-san*[6] (Fig. 12)[1] and the *Sida rhombifolia* L. *pai-pei huang-hua-jen*[7],[e] which are all used as substitutes for the real jute[h] *Corchorus capsularis* L. *huang-ma*[B] (Fig. 12) especially in the rope-making industries and in the manufacture of paper.[1]

The *Abutilon* was planted on a large scale in north China,[j] in the area of Manchuria and in Szechwan province. The plant is an annual, growing up to a height of 2 m, has hairy leaves and yellow blossoms. Growth is completed within some 10 weeks and harvest occurs just before the plant starts to blossom. Then the skin with the bark is peeled from the stem and boiled in water. Thereafter all traces of wood are cleaned from the fibres, which are then dried in the sunlight. The fibre material thus obtained is strong and suitable for all coarse textiles.

The *Skuo Wen Chieh Tzu* defines the *chhing*[9] *f* also written *chhing*[101] as male hemp Att'[u].[m] The *Til Phien* explains *chhiung*[12] *as chhing*[13],[n] also known as *chhing*[1]*.[0] The *Erh Ta I* (Assisting Notes to the Erh Ya Dictionary) of + 1174 by Lo Yuan (+ 1136 to + 1184) says:[p]

The abutilon plant belongs to the foz-hemp plants. It grows to a height of *c.* 4-5 or 6-7 feet. Its leaves are scanty like those of the ramie plant and its seed resembles that of hemp. Nowadays people splice the fibre and manufacture cloth as well as making ropes of it. Other names for the plant are *chhiung*[12] and *Ming*[15].

Plain unlined garments, often used as dust-coats, were made of the *Abutilon* fibres and called *chhiung*[16].[q] As early as in the *Chung-yung* (Doctrine of the Mean) we can read:[r]

It is said in the Book of Poetry: 'Over her embroidered robe she puts a plain, single garment', intimating a dislike to display the elegance of the former.. .[8]

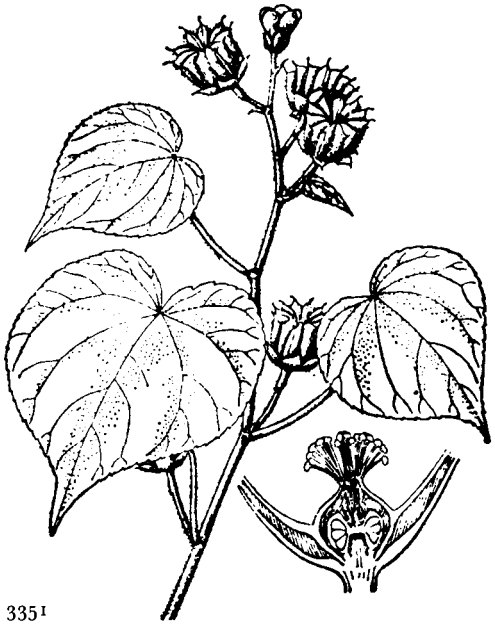
[1] Bretschneider (/), vol. 2, pp. 207-8; Anon. (6oi); for more Chinese information, consult the *MLTW,* pp. 261—80 supplying reference material.

» *CWTTT,* no. 31528.
a *CKKTCW,* vol. 2, p. 811.
' *Ibid.,* p. 810.
ï *GTL,* vol. 1, p. 640.
> Wagner (1), p. 360.
> JVS, ch. 10, p. 13a.
[n] *Ta Phien,* ch. *chung,* p. 24a.
" *Erh Ta I,* ch. 8, pp. 90-1; the text is also partly contained in the *NS,* ch. 10, p. 13a, *NCCS,* ch. 36, p. 2a; *MLTW,* pp. 262-3, no. 284.
[r] Legge (2), *The Doctrine of the Mean,* chapter XXXIII.

c *CWTTT,* no. 31793.
« *Ibid.,* p. 812.
« *Ibid.,* p. 810.
' *Ibid.,* vol. 1, p. 13.
[k] JVCGS, ch. 36, p. 2a.
[m] *SWCT,* ch. 7 *hsia,* p. ia.
° *Ibid.*
1 *MLTW,* pp. 262-3.

[8] Karlgren translated a similar text as follows: 'I will have for a jacket my brocade jacket and my unlined slip-over jacket. I will have for a skirt my brocade skirt and my unlined slip-over skirt.' See, Karlgren (14), p. 58, no. 88 (3).

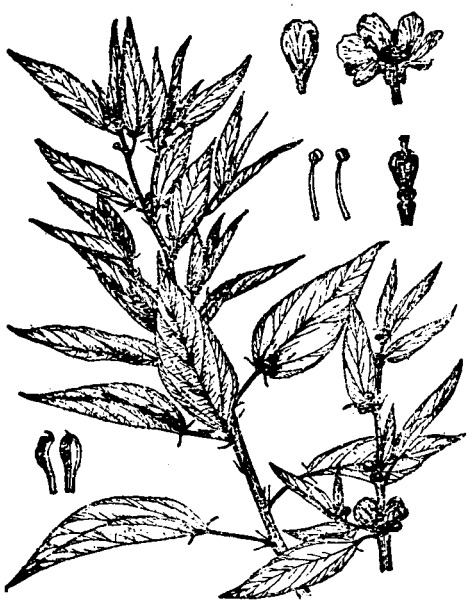
[1] 苘麻 [2] 蔴麻 [3] 蔴 [4] 肖梵天花 [5] 野棉花
[6] 拔毒散 [7] 白背黃花稔 [8] 黃麻 [9] 絲 [10] 蠶 [11] 枲
[12] 苘 [13] 絲 [14] 蔮 [15] 蔮 [16] 褧，絅



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Fig. 12. Bast fibre plants. Anon. (*109*), vol. 2; 3351, *chhiung-ma*[1], *Abutilon theophrasti* Medik.; 3349, *pa-tu-san*[2], *Sida szechuensis* Matsuda; 3334, *huang-ma*[3], *Corchorus capsularis* L.

[1] 苘麻 [2] 拔毒散 [3] 黃麻

Li Shih-Chen (+ 1518 to +1593), naturalist and pharmacologist, named the plant in his *Pen Tshao Kong Mu* (Pharmacopoeia) *pai-ma*[1] 'white hemp';[a] in Chhing times it was also known as *chhing-ma*[2] 'green hemp'.[b]

The *Nung Shu* of + 1313 informs us about the processing and the use *oîAbutilon* : °

Abutilon ripens at the same time as the *Corchorus capsularis* (jute) does. After reaping, it is tied in small bundles and soaked in ponds. When the green skin has rotted away, a hemp fibre pure and white as snow can be obtained. This fibre is resistant to water and does not decompose. It is woven into matting, made into well-ropes *(chi-keng*),* cattle-ropes *(niu-soY,* used for cattle-blankets *(niu-i*[5]*),* rain-coats, grass-coats to wear over the back and other items. For the workers, year after year, it is indispensable.

Jute, *Corchorus capsularis* [d] *huang-ma*[be].> is an annual plant of Indo-Burmese origin,' which belongs to the family of the *Tiliaceae,* and like many plants of the *Corchorus* group is useful as a textile fibre.[8] Just for local needs, jute was cultivated all over China; it gained modest economic importance in Szechwan, Hopei and Kuangtung. Nowadays Chekiang province is the main centre of jute growing in China, producing far more than any other area. The Chekiang ma-fang-chih-chhang[7] in Hangchou, which produces nothing but jute sacks, employs several thousand male and female workers in the workshops for spinning and weaving.[11]

Jute is planted in the second or third month and harvested at the end of summer or in early autumn. The fibres are obtained from the stem, which grows to a height of 2 m and more. The leaves of the plant can be eaten as a vegetable, the slender stems—after being dried in the sunlight—serve as firewood. The fibre of the jute is yellowish-brown in colour, difficult to bleach and not very high in quality. But since the cultivation is easy and good harvests can be obtained, it is still grown today. The processing of the fibre is similar to the techniques already described.

The history of jute is not well recorded in China and the earliest reference seems to be from the Chin dynasty, where a tomb was excavated at Nan-chhang[8] in Kiangsi province. This yielded one piece of a lined long robe and one piece of an unlined garment, both made of jute.[1] In Northern Sung times jute is mentioned in the *Thu Ching Pen Tshao* (Illustrated Pharmacopoeia) of + 1061, edited by Su Sung (+ 1020 to +1101), which has been lost, but fortunately quoted in various other works.J

[a] *Pen Tshao Kang Mu,* vol. 3, ch. 15, p. 42; *NCCS,* ch. 36, p. 2a.
[b] *NCCS,* ch. 36, p. 2a. [c] *MS,* ch. 10, p. 13b.
[a] *GTL,* vol. 1, pp. 243, 640-1.
[e] *MLTW,* pp. 286-90; *CKKTCW,* vol. 2, pp. 802-4.
' Simmonds (1), pp. 290-1; Bally (2), pp. 3886-909.
« *CKKTCW,* p. 803, p. 804.
[h] We visited the factory on the 6 October, 1979.
' Anon. *(622),* p. 375, listed on pi. 8, top row. In ancient times all sorts of yellow fabrics were called *huang-ma* and jute certainly was among them. Whether the pieces found are made of jute is doubtful, but *huang-ma* appears on a written document as 'unlined garment'. Phan Chi-Hsing holds the opinion that *huang-ma* is a kind of paper *Pa-chhiao-chih*[9] made of jute fibres. ' *MLTW,* p. 287.

[1] 白麻 [2] 青麻 [3] 汲梗 [4] 牛索 [5] 牛衣
[6] 黃麻 [7] 浙江蔴紡織廠 [8] 南昌 [9] 壩橋紙

In Ming and Chhing times, the plant was known as *lo-ma*[1] [a] or *lii-ma*[2],[b] in Szechwan also as *pai-ma*[3].°

The *San Nung Chi* (Record of the Three Departments of Agriculture) of + 1760 by Chang Tsung-Fa informs us:[d]

> After having peeled the fibres (from the stems), they can be made into threads and subsequently woven into cloth. It is possible to make robes with the fibres. When making sandals, their quality is extremely good. For paper production, too, the material is excellent.

In pre-modern Chinese literature, *theya-ma* or* (Shansi) *hu-ma,*[s] *Linum usitatissimum* L.[e] is not mentioned. In 19th and 20th century China it was cultivated in Shansi, Inner Mongolia, and in the mountainous parts of Hupei and Szechwan, mainly to obtain oil from the crushed seeds. As a textile fibre plant it gained no importance.*

The paper-mulberry *chhu*[6], *Broussonetia papyri/era* Vent.[g] of the *Moraceae* family, played an important role in the production of paper, and may also have been of minor importance in the manufacture of textiles. From our general knowledge about bast fibres, we can conclude that the paper-mulberry fibres were obtained and processed in the same way as the banana fibres: stripping the stem, then boiling the bast material in lime to make it easier to dissolve. After that comes the splitting, and finally the splicing and spinning into yarn. A characteristic of the bark of this type of tree is that the fibres will separate easily when beaten and pounded, opening out into a net-like mesh. This is the principle for making bark-cloth (tapa) from species related to the tree. It is made in this way in the scattered archipelagos to the south of China by people who do not know how to spin or to weave. In the case of mainland China, however, woven cloth made of tree-bark fibres was certainly produced by minorities, and on a small scale by Han-Chinese. One might guess that the techniques of bark-cloth making—as it was practised in Chou times—have to be seen in connection with the invention of paper. The techniques of bark-cloth manufacture may have contributed to the rapid development of paper-making after the Han dynasty and thus formed the base for the production of paper of excellent quality.[11]

In the *Shuo Wen Chieh Tzu*[1] *chhu*[6] is defined as *ku*[7] which should not be confused

» *MLTW,* p. 289.
[b] *MLTW,* pp. 286-7, *Shao-Hsing Hsin-Chhang-Hsien Wu Chhan Piao,* no. 246.
[c] Wagner (1), p. 361.
[d] *San Nung Chi,* in *MLTW,* pp. 289-90.
« *CKKTWC,* vol. 2, p. 535; *GTL,* vol. 1, pp. 446-7; vol. 2, p. 26; Plonka (1), pp. 3-9; Hermant (i), pp. 10-17. ' Wagner (1), p. 362.
s Bretschneider (1), vol. 2, pp. 333-4; vol. 3, p. 499; .MS, ch. 10, pp. 7b-8a; Ling Shun-Sheng (7).
[h] The monograph by Ling Shun-Sheng (7) contains a number of profound articles on the subject. Our short resume is based on the following articles: Ling Shun-Sheng *(13),* pp. 1-30; Ling Man-Li (/).
1 *SWCT,* ch. 6 *shang,* p. 7a.

[1] 絡麻 [2] 綠麻 [3] 白麻 [4] 亞麻
[5] (山西) 胡麻 [6] 楮 [7] 穀

with *ku'* corn. Both are names for the paper-mulberry. Lu Chi (+ 261 to +303) explained in his *Mao Shih Tshao Mu Niao Shou Chhung Tii Shu* (Commentary on Botanical and Zoological Terms in the Mao-Edition of the *Shih-Ching)* :[a]

The people of Yu-chou[2] call the tree *ku-sang*[3], the £«-mulberry, or *chhu-sang**, the *chhu*-mulberry. In Ghing[5] [Hunan, Hupei], in Yang[6] [Chiang-nan] and in Ghiao-kuang[7] [Kuangtung] its name is *ku;* in Chung-chou[8] the people call it *chhu.*

The people in the Chiang-nan region splice the fibres of the bark into yarns to manufacture cloth; they also pound the bark to make paper.

It should also be mentioned that not only the paper-mulberry tree served as source for textile raw material; probably many trees were tried, for example the *wu-thung*[9] *Sterculia platanifolia,* from which fibres to make cloth were obtained in Han times .[b]

In the course of time the paper-mulberry lost its importance as a textile raw material but dominated in the manufacture of paper. Thus we learn from the *Chhi Min Too Shu* (Important Arts for the People's Welfare) of *c.* +533 to +544 by Chia Ssu-Hsieh:[0]

If you just sell the land as worked, you will save labour, but the profit will be small. If you strip and boil the bark (from the paper-mulberry) and sell it, you will have a lot of work but the profits are high.

Although cotton *(mu-mien'°, mien-hua")*[d] does not belong to the bast fibre plants but to the seed fibre plants, it has to be treated in the context of textile fibre plants because of its outstanding economic importance in China, particularly from the thirteenth century to the present. A short resume of the plant's history in China may serve to give a general impression. It is mainly based on the thoroughly compiled collection of sources, edited by Chhen Tsu-Kuei[e] and on the profound study by Chao Kang.[tg]

Two species of cotton existed in China, the *Gossypium herbaceum* and the *Gossypium arboreum.* The upland cotton *Gossypium hirsutum* was not introduced into China until + 1898.[11] They all belong to the family *Malvaceae.*

The *Gossypium herbaceum*[1] is a short-season annual plant producing short-staple fibres of inferior quality. In the first millennium it was known in China under

[a] *Mao Shih Tshao Mu Niao Shou Chhung Tii Shu,* ch. *shang,* pp. 29—30. *Khang-Hsi Tzu Tim,* **p.** 469.

D ***Hou Han Shu,* ch. 86, pp. 2849-50.**

[0] **Shih Sheng-Han (p), ch. 48, p. 280.**

[d] *Mien-hua*[11] is true cotton. *Mu-mien* can mean cotton, but also kapok, the cotton-like floss from **a** tree. **The fibre cannot be spun and can only be used for such purposes as stuffing sleeping-bags. *Mu-mien* has been identified as *Bombax malabaricum,* vol. 4, pt. 2, p. 124, and as *Ceibapentandra,* vol. 6, pt. 1, p. 89 (c).**

[e] Chhen Tsu-Kuei *(1). Mien Teh Thu Shuo"* (Illustrated Account of Textile Production); Anon (537); **Feng Tse-Fang *(1).*** **< Chao (1), Chao Kang (2).**

« For further up-to-date information see *GTL,* vol. 1, pp. 131-6, 537-8; Watson (1); Chao Ya-Shu (/), pp. 222-44; Phillips (1), pp. 197-200. [h] **Chao (1), p. 4.**

[1] Hutchinson, Silow and Stephens (1), p. 85.

[1] 穀 [2] 幽州 [3] 穀桑 [4] 楮桑
[5] 荊 [6] 楊 [7] 交廣 [8] 中州
[9] 梧桐 [10] 木棉 [11] 棉花 [12] 棉業圖說

the name of *pai-tieh*[1].* Originating in the Indus Valley civilisation of modern Pakistan,[1]* it travelled along the silk-road eastwards to China, but because of climatic conditions—cotton needs high humidity for growing and manufacturing—only two regions in Sinkiang proved to be suitable for its cultivation and the manufacture of comparatively coarse cloth. These were the basin of Turfan (formerly Kao-chhang[2]) and Khotan (formerly Yü-thien[3]). Archaeological evidence dates from Late Han times, giving us not only cotton fabrics, but also cotton seeds of the *Gossypium herbaceum."* Textual evidence can be found in the *Liang Shu* (History of the Liang Dynasty, [+502 to +556]):[d]

(Kao-chhang) has many herbs, the fruits of which are like cocoons. In the cocoons are fine fibres *(hsi-lu*)* like silk. Their name is *pai-tieh*[5] seeds. Many people of that country take the material and weave it into cloth, which is soft and white. It is used for trade at the market.

There are still more pre-Sung references to cotton known to us from other sources.[e] Textual evidence from post-Sung times is so copious that it would be a tremendous task just to collect the titles of the books and treatises.[1]

It is not surprising that the *Gossypium herbaceum vor. acerifolium* spread only very slowly through Kansu to Shensi province, and not further east. The quality of the cotton fibres could not compete with the quality of the cloth produced from the semi-continuous filaments of ramie and the excellent qualities of silk. Certainly there was cotton cultivation in the north-west, but it can hardly be considered as having been economically successful or culturally important.

The perennial *Gossypium arboreum,* formerly called *chi-pei*[6] in China—a transliteration of several Sanskrit names such as *karpasa*«—originated in East Bengal[h] and arrived in Yunnan province via Assam and Burma. In Thang times and before, anodier name for cotton cloth was *thu-tu-pu'"*, a transliteration of the Sanskrit term *tulä* which means cloth woven from the *Gossypium arboreum.*[1]

Cotton is already mentioned in the *Hou Han Shu* (History of the Later Han Dynasty, [+25 to +220]), where we read that the Ai-lao[8] tribe in west Yunnan used it;' furthermore it appears to have been a speciality of Szechwan province.

» *Pai-tieh* is a transliteration of the Sanskrit word *patta,* see Chao (i), p. 5.

[b] Bray (1), pp. 536-7. Cotton is known both from Mohenjo-Daro and Harappa and **must have been** cultivated there before —2300; Vishnu-Mittre (1); Hutchinson (2), pp. 3-33.

= ShaPi-Thi (/), pp. 48-51.

[d] *Liang Shu,* ch. 54, p. 811.

[e] Chhen Tsu-Kuei (/), pp. 18-21.

' *Ibid.,* pp. 22-203; in the context of our study it appears unnecessary to list all the **works in western 1** anguages dealing with old world cotton and its history in China. The most important **works are contained** in the bibliographies of Chao (1), pp. 375-85 and in Watson (1), pp. 363-8.

s Chao (1), p. 8. * Hutchinson, Silow and Stephens (1), p. 83.

[1] Chao (1), p. 9: we were unable to find *tulä* in this meaning in Sanskrit; Monier-Williams (1), p. 451.

1 *Hou Han Shu,* ch. 86, p. 2849.

[1] 白疊, 白叠 [2] 高昌 [3] 于田 [4] 細繓 [5] 白疊
[6] 吉貝 [7] 土蘆布 [8] 哀牢

It was known as *Shu-pu*[1], Szechwan cloth,[a] according to the *Shih Chi* (Record of the Historian).[b] This species of cotton spread slowly but continuously from Yunnan to Kuangsi and Indo-China, to Kuangtung and to Fukien province. By Sung times the plant had reached the Chiang-nan area.[0] We can accept the theory that by the end of Sung times the perennial 'small trees' had evolved into annual shrubs with longer capsules, which meant higher yields and better control of the plant and its cultivation.[d]

Apart from the biological evolution which had to take place to make the plant suitable for cultivation on an economic basis, there were a few technical problems such as ginning and carding which had to be solved, before successful mass production could occur. Only the invention and use of the cotton-gin and cotton-bow[6] laid the basis for solving this problem. To wards the end of the + 13th century the botanical and technical requirements were met in the Sung-chiang area (nowadays Greater Shanghai); from then on the production cost of cotton fibres could compete with silk and ramie, and soon reduced the importance of all bast fibres used in the manufacture of textiles.

[a] Whether the cloth which Chang Chhien saw in Bactria was produced in Szechwan may be open to discussion (see Chao (1), pp. 9-1 o). That advanced Szechwanese weaving technology improved cotton piece goods and made them a commodity which could fetch high prices in Central Asia, as Chao Kang suggested, sounds rather reasonable.

[b] *Shih Chi*, ch. 116, p. 2995.

[°] *Tzu Chih Thung Chien*, ch. 159, p. 4934 (commentary by Hu San-Hsing of Yuan times); *Khang-Hsi Tzu Tun*, p. 459. * Chao (1), p. 13.

[e] See below, ch. (</), (1), (iii), *(ß).*

[1] 蜀布

(c) HAND-SPINDLE SPINNING: THE SIGNIFICANCE OF THE HAND-SPINDLE IN THE HISTORY OF SPINNING TECHNOLOGY

The hand-spindle, which consists of a rod and a whorl, is generally considered to be quite a simple instrument for spinning and twisting yarn, and an appropriate tool for use by neolithic peoples and primitive tribes. This is true, but it should be added that its use has continued until the present day, because it is inexpensive to make and relatively easy to operate at any place and at any time, sitting, standing or walking. It is suitable for all workable textile fibres.

The quality of yarn produced can be of outstanding fineness and evenness, yielding better results than the hand-operated spinning-wheel or the treadle-operated wheel. For example, Swiss cotton yarn spun on hand-driven spinning-wheels could not compete with the quality of the hand-spun yarns.[8.] In China, hand-spun ramie yarn could be made three times finer than the best machine-spun quality produced today.[b] These excellent results are due mainly to the raw material, to the speed of spinning, the way the yarn is fed, and the superior degree of control obtainable with it. Its simplicity and the good results it gives, have guaranteed the survival of the hand-spindle in many regions of the world, even at the present time.[0]

Starting from the early neolithic period—the finds of which will be discussed shortly—through Egyptian,[4] Greek and Roman times,[6] during the Middle Ages' and right up to the present, there are abundant references to the hand-spindle,

» **Linder (i), p. 58.**

[b] *GTL*, **vol. 2, p. 216.** « **Linder (1), pp. 58-60.**

[d] **Schliemann (2), (Engl, reprint: New York, 1976), p. 294, fig. 139a** ***'Berti Hasan':*** **Egyptian spindles of wood, cane, plaited basketwork from Thebes on p. 295, fig. 139c. Wilkinson (i), vol. 2, p. 172, no. 388. Erman (1), p. 450. Pétrie (6), pi. XXVI: 66, 67, 69, 71; Pétrie (1), pp. 53-4; pi. LXV: 143 (high-whorl spindles). Forbes (13), vol. 4, pp. 152-5; Crowfoot (1), p. 425.**

[e] **Schliemann (2), pp. 296-8: 'Spinning and Spindle Whorls among the Greeks and Romans'; Blümner (i), vol. I, pp. 132-3; Crowfoot (1), p.** 444, **fig. 281; Forbes (13), vol. 4, p. 162, fig. 15; p. 163, fig. 16; Wild (1), pp. 31-40.**

[' **The best and most complete collection of illustrations on the subject so far can be found in Brandt (1), vol. 1, p. 222, Abb. 281 ; p. 228, Abb. 291 ; p. 229, Abb. 292; p. 230, Abb. 295-8; p. 231, Abb. 299, 301-2; p. 233, Abb. 304; p. 281, Abb. 393; p. 283, Abb. 397; p. 284, Abb. 398, 399; p. 303, Abb. 427; vol. 2, p. 24, Abb. 8; p. 132, Abb. 156; p. 168, Abb. 224-6; p.** 169, **Abb. 227-8. An illustration from an Italian manuscript of** +1023, Monte Casino, Monastic Library **MS 132 is pictured in Amelli (1), pi. XCVI,** also in Patterson (1), p. 202, fig. 165. A fourteenth century French Aristotle-manuscript in the Bibliothèque **Nationale, Paris, MS 9106 is pictured in Wescher (1), p. 2381 ; Patterson (1), p. 203, fig. 166. A Nuremberg** woodcut off. + 1490, österreichische Nationalbibliothek, Vienna, is pictured in Brandt (1), vol. 2, p. 168, A66. 226; Patterson (1), p. 208, fig. 173. For the French miniature 'Adam and Eve at work' and the same subject pictured in the *Heilspiegel von Richel*, see Brandt (1), vol. 1, p. 229, Abb. 292; p. 231, Abb. 301; also pictured in Linder (1), pp. 10-11, figs. 3, 4. The whole family at work in Egypt, Armenbibel, cod. lat. 28.141, Munich can be seen in Linder (1), p. 41, fig. 38. The Österreichische Nationalbibliothek, Vienna, preserves a miniature (cod.s.n. 2598) from the end of the + 15th century (Lyons?) showing Mary in a box-shaped room, sitting behind a vertical framework of a loom. In her right hand she holds a distaff as it was used for spinning. It is too big to be considered as a shuttle. In our opinion she is spinning yarn; see Pacht and Thoss (1), Text (vol.), p. 144; (Plates), Abb. 310; Wittlin (1), p. 702.

various types of which could still be seen in China in the present century,* and may still be employed in remote areas. Further evidence that the hand-spindle is the oldest textile-technological implement with a continuous history of use over the last 7,000 years or so, is to be found in its pictorial representations.

Conclusions about how Chinese spindle-whorls were driven can only be drawn from comparative studies of other cultures, especially the Egyptian. But before we can concentrate on the Chinese whorls several questions should be asked and answered if we are to get a clear idea of the hand-spindle and the way it worked. Thus we have to inquire about the origin of spinning, about methods of using the spindle and its efficiency. We need only look at early sites yielding whorls outside China to realise that the whorl was not a device restricted to one region in the ancient world. Only after this can we consider the finds of spindle-whorls by Chinese archaeologists.

(1) ATTEMPTS TO EXPLAIN THE ORIGIN OF SPINNING TECHNOLOGY

We do not know who invented spinning as a means of producing yarn, nor who invented the spindle-whorl.[b] Even to claim that there was only one way in which spinning could have been invented is mere conjecture. Theories have been proposed[0] but, due to their eurocentric bias, all have neglected archaeological hints to be found in 'cord-marked' pottery. Yet to explain the history of Chinese spinning technology it is vital to begin by discussing cord-marked impressions on pottery, not only for technical but also for chronological reasons. For Europe and other parts of the world no such explanation is at hand; here we still have to rely on logical reasoning with all its inherent pitfalls.[d]

The earliest evidence for the existence of textile technology and textile structures are cord-impressed sherds of pottery, small relics of matting, and mat-impressions. This is because hand-made cords are the forerunners of all spinning and subsequently provide examples for real weaving techniques.

The technique of decorating pottery with cord-marks is most probably of Far Eastern origin, and is one of the oldest types of such decoration in the world.[6] As we know from the Hoabinhian culture in northern Vietnam, mat-marked pottery may be considered contemporary with the cord-marked pottery of the Jômon (cord-pattern) culture in Japan, dated about —8ooo.[f] The strands on the cord-marked pottery from the Hsien-jen-tung[1] (Cave of the Immortals) in Kiangsi

• Hommel (i), p. 167, fig. 244; p. 168, figs. 245, 246; Montell (4), p. 115, pi. **Ill;** p. 113, fig. 2; p. **114,** fig. 3; pi. 1:4.

" La Baume (3), p. 31.

[c] *Ibid.,* pp. 31-3.

[d] As far as we know, no new explanation has been published in recent years.

[6] Ho Ping-Ti (5), pp. 123-8. An excellent discussion on impressions on pottery (including an extensive bibliography) can be found in Ling Shun-Sheng (7).

» Chang (6), p. 4.

[1] 仙人洞

province, the lower stratum of which is dated between —7115 and— 6635,[11] varied in thickness between 1 mm and 2.5 mm. The diameters of the strands on the sherds excavated at the site of Pan-Pho-tshun[1] in Shensi, dated between — 4225 and — 4005^ ranged from 0.5 mm to 4 mm.[0] Another site with characteristic cord-marked pottery was Ta-phen-kheng[2], northern Taiwan, from about —4450 to —4350, though the dating could range from the —3rd to the — 10th millennium.[11] The marks on the pottery reveal that the cordage techniques must have been highly developed, and that fibres for the cord were made of plants from the abundant local flora.[0] Many other early cord-marked pottery sites are reported from Kuangtung, Kuangsi,[1] and also from the earliest phase of the Yang-shao[3] culture,[8] where it was followed later by painted pottery.[11]

Outside China we have the sites of the Thailand 'Spirit Cave',[1] dated as being from the —6th millennium, the site of Laang Spean in Cambodia, the —5th millennium, and Padahlin in Burma, also —5th millennium. They are all attributed to the Hoabinhian cultural phase, a site near Hoa Binh, west of Hanoi, and show pottery with cord-marks.[ä]

Ho Ping-Ti came to the conclusion that the earliest ceramics everywhere in Asia are characterised by cord-marking, that it seems reasonable to assume that Chinese cord-marked pottery is of Far Eastern origin and, finally, that the earliest pottery of the Yang-shao area derived from the southern half of China.[k]

How should the term cord on cord-marked pottery be defined? Chinese archaeologists distinguish between *sheng-wen*[4] and *hsien-wen*[5.1]. The structure of the *sheng-wen* is coarse, although there are fine details; many small shapes like foursided figures with four angles form the overall pattern. The structure of the *hsien-wen* ' thread-or-line-pattern ' is finer than that of the *sheng-wen.* The pattern consists of the 'threads' or 'lines' arranged in parallel, mostly in a vertical direction on the pottery. In this context, then, it appears useful to define a cord as a thread-like textile structure composed of one or more threads, either tightly twisted or corded together. The material is comparatively hard and coarse, made of plant fibres, types of grasses, rushes, reeds and fibres from trees.[m] Such a definition is supported by the *Shuo Wen Chieh Tzu* (Analytical Dictionary of Characters) of +121 by Hsii Shen where *sheng*[n] is defined as *so*[b0] 'plants have stalks and leaves (out of which) one can make cords'.

[a] **Kuo Yüan-Wei, Li Chia-Ho (/), pp. 1-16; Chang (1), pp. 89, 511, 513; Chang (2), pp. 222-3; Ho Ping-Ti (5), pp. 124-5.**
b Chang (1), p. 485. **[c] Anon. *{671),* p. 162.** **« Chang (1), p. 85.**
***«Ibid.*, p. 87.** **' *Ibid.*, pp. 121-2.**
[B] ***Ibid.*, p. 122; Ho Ping-Ti (5), p. 126.**
[h] **Chang (i), p. 122; Ho Ping-Ti (5), p. 127.**
[1] **Gorman (4), pp. 671-3.** **' Clark (4), p. 341.**
[*] **Ho Ping-Ti (5), pp. 125-8.**
[l] **Wu Shan (1), p. 68, fig. 3: 1-4; p. 60; Anon. (675), p. 89.**
[m] **Anon. (602), p. 329; Chang (6), p. 21; Chang (1), p. 87.**
[n] ***SWCT*, ch. 13 *shang*, p. 10b.** **° *Ibid.*, eh. 6 *hsia*, p. 2a.**

[1] 半坡村 [2] 大坌坑 [3] 仰韶 [4] 繩紋 [5] 線紋 [6] 索

At present it is still very difficult to identify the textile plant fibres which have actually been used to imprint pottery* but we can say that the plants listed below were of major importance for this purpose:[b] all sorts of bark from trees such as the paper-mulberry, *Broussonetia papyrifera (chhu*),* the caster oil plant *{pi[2]),* the willow tree (h'u[3]),[c] ramie, *Boehmeria nivea (chu-ma*),*[d] *Themada triandra (chien[s]),*[e] many sorts of grass,[1] such as the *Scirpus eriophorum* Michx. and the *Scirpus cyperinus* var. *(khuai[6]),*[s] the *Scirpus lacustris* (/wan[7]),[h] the *chien^-grass,*[1] dry straw *(kao[9]),** the reeds *Phragmites Roxburghii,* Kth. *(lu[10])* and the *Phragmites communis,* Trin. *(wei[u]),* the *Arundo indica (lu-wei[12])** the rushes *Typhajo[131]* or jo[14 m] or the *mao[15 n]*.

As can be observed from their impressions, the cords were not flat like elastic bands but had a spiral put into them by a kind of 'twisting'. Such twists were achieved by rolling the raw material between the fingers, between the palms of the hands, or between the fingers and the thigh or the cheek. The spiral added strength and elasticity to the material.

Theoretically there were at least two methods of impressing the sherds: either the cord was used directly and pressed on to the surface of the pot—a tiresome and inefficient method—or more frequently, the cord was wound around a type of beater *(phai-tzu),* a technique for which there is evidence from the field and from archaeology. Within the beater-technique, Ling Shun-Sheng distinguished two ways of producing the designs: the pat-impressed *lan-wen[l6]*, 'basket-pattern', and the press-impressing *ko-wen[17]*, 'pattern of squares formed by crossed lines'. Only the former is of interest to us, because it produced the pattern with corded beaters; the other, invented later, and less popular, needed printers (so-called pottery-printers) with cross-hatching designs.[0] Even today the Wa»[8] tribe and the Thai" tribe in the south-west of Yunnan province manufacture impressed pottery-ware,[1]* while about fifty years ago, corded beaters were still used by the Naga in Assam.*[1]

(2) SPINNING BY MEANS OF THE HAND-SPINDLE

We do not know how it was discovered that plant and animal fibres are separable, although a few theories exist to explain how it could have happened.[1] Probably

* No systematic research has been done on this subject.
[b] For additional material which could have been used, see also Tod and Benson (1); Will (1).
[0] Wu Shan (/), p. 60. [a] Anon, *{671),* p. 162. [e] *CWTTT,* no. 31853.
[1] *Kuang-Ming Jih-Pao* 6: 6 (1973), p. 3: report on the site of Tshao-hsieh-shan.
[g] *CWTTT.* no. 32390. [h] *CWTTT,* no. 31694.
[i] *CWTTT,* no. 32727. [1] Karlgren (1), no. 1129g.
[k] Anon. (7//). [l] Karlgren (1), no. 1123a.
[m] *CWTTT,* no. 32325. [n] *CWTTT,* no. 31477.
[0] Ling Shun-Sheng (7), pp. 132-3; Shih Chang-Ju (1), p. 68.
» Li Yang-Sung (/), pp. 33-7; Chang Chi (/), pp. 488-9. * Hutton (1), pp. 53-5.
[r] Horwitz (5); Horwitz (14), pp. 1782-1808; La Baume (3), pp. 31-9.

[1] 楮 [2] 蔴 [3] 柳 [4] 苧麻 [5] 管 [6] 蒯 [7] 莞
[8] 蘭 [9] 藁 [10] 蘆 [11] 葦 [12] 蘆葦 [13] 弱 [14] 蒻
[15] 茅 [16] 籃紋 [17] 格紋 [18] 瓦 [19] 傣

observation showed that fibres, when moistened, start rotating in a certain direction during drying.[a] This direction or spiral disposition put into a yarn is called the twist; it is either right-spun (Z-direction) or left-spun (S-direction).[b] Henry Hodges explained it:[c] 'If, viewed from above, the movement of the spindle is clockwise, the resulting thread will have spirals conforming to the slope of the central part of the letter Z, and is referred to as Z-spun, or, by analogy with the thread on the carpenter's screw, right-handed; while if the spindle is made to rotate in the opposite direction, the resulting thread will be referred to as S-spun or left-handed.'

The direction of rotation might well have been taken into consideration as soon as spinning began. For instance, linen is a fibre of S or left-spun type,[d] and this was the general spinning direction of the material in Egypt and Mesopotamia, where linen with S-spun warps and wefts has been found.[e] Cotton was usually spun in a Z-direction, as can be seen from cotton finds at Fostat.[1] Yet though the natural spinning properties of the fibre material are important for the spinning direction, they should not be overestimated. Another important factor would be whether the spinner was right-handed or left-handed. In thigh-rolling, and usually in spindle-spinning too, it is a rule that a right-handed spinner produces a Z-spun yarn; a left-handed spinner a S-spun yarn. Hodges has put it as follows:[g] 'Unusual spinning may thus be as much a matter of personal idiosyncrasy as of a tradition stemming from the use of a different fibre.'

Hence we may summarise by saying that the best way to spin the fibres of the raw material was in the spinning direction suitable to their natural disposition and the personal liking of the spinner.

At the start, the short-staple fibres were rolled between the palms of the hands or on the thigh where drawing out and twisting was performed simultaneously, or the spinner first drew the fibres out and afterwards rolled them (Fig. 13). Both methods could only produce what we should now consider to be a very loose

» Even today the moistening of plant fibres constitutes one working step in the spinning process.

» Forbes (13), vol. 4, p. 150: he uses the definition of the American Society of Testing Materials: A yarn has a S-twist if, when held in a vertical position, the spirals conform in direction of slope to the central position of the letter ' S ' and Z-twist if the spirals conform in direction of slope to the central position of the letter ' Z \ Dorothy K. Burnham (1) has published a definition in her *Warp and Weft. A Textile Terminology* (Toronto, 1980), which is based on the *Vocabulary of Technical Terms* (Lyons, 1964), published by the Centre International d'Études des Textiles Anciens (1). Her definition on p. 161 reads: Twist - the twist of a thread around its axis resulting from spinning, twisting, throwing, or plying. The direction of the twist is indicated by the letter 'S' or 'Z'; the spiral of the thread corresponds to the central bar of the letter. The tightness of the twist is indicated by the number of the turns in a given unit of length; it may also be indicated by the helix angle. Still another definition but more difficult to read is given by Emery (1), p. 11. A list of works dealing with the production of yarn and thread can be found in Seiler-Baldinger (1), p. 3.

[c] Hodges (1), p. ia8.

[d] Forbes (13), vol. 4, pp. 150-1 ; the investigation of the fibres was executed by the Textile Museum Washington D.C.

[e] Morgan (1), vol. 3, p. 52; Ghirshman (1), vol. 2, p. 202; the fragment is discussed by Pfister (3) in his article included in the volume on pp. 201-2. The plate no. XXII: 13 is a misprint; the fragment is actually pictured on pi. XXXII: 13. Crowfoot (1), p. 432.

' Forbes (13), vol. 4, p. 151.

« Hodges (1), p. 128.



Fig. 13. Rolling wool fibres on the leg preparatory to spinning, Attic cup, −5th century. From Brandt (1), vol. I, p. 83, Abb. 95.

sort of 'hank' which untwisted easily and was called a 'roving'. It needed to be spun into a really tight yarn afterwards. The technique of rolling on the thigh may have developed from a splicing technique as it was applied in the long-staple bast fibre technology to manufacture a continuous yarn before spinning. As the mural painting of Daga[a] reveals, the worker spliced single long fibres of flax, probably by glueing them together with saliva or by knotting them. The work of splicing resulted in a ball, the shape into which the continuous yarn was wound. For the splicing as well as for making a roving of equal quality, the spinner may have employed a flat hard surface for the rolling process, thus avoiding constant friction on the thigh.[b] There is no pictorial or archaeological evidence for such a simple, flat, board-like surface, but it appears likely that from this 'board' the more efficient onos or epinetron, *(epi* = on, *neo* = I spin), may have developed, an instrument on which spinning is done. It can be dated the — ist millennium of Greek culture, and was a shape which fitted on the thigh. Its surface had a ' fish-scale' pattern, which facilitated laying the short-staple fibres parallel while rolling them on the surface of the onos, and thus manufacturing the roving which afterwards had to be spun into yarn with the hand-spindle. It has been pictured and described many times.[0] European evidence comes from Greece, but we cannot

[a] **Davies (i), pi. XXXVII.**

[b] **To reduce the friction, people often used gypsum rubbed on the spinner's thigh. Frödin and Nordenskiöld (i), p. 18.**

[c] **Häuser (i), p. 83; Blümner (1), vol. 1, p. 113, fig. 37 'Herstellen des Vorgarns'; p. 115, fig. 39; pp. 115-20, figs. 40, 41. Neuburger (1), p. 171, fig. 237, fig. 228; Schliemann (1), pp. 296-8; Forbes (13), vol. 4, p. 161, fig. 14; p. 164, fig. 17.**

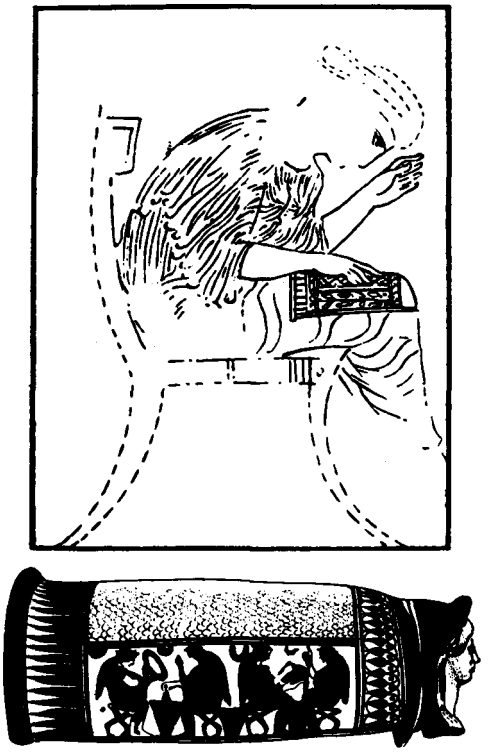


Fig. 14. Use and shape of the epinetron in rolling wool, from a painting on an Attic epinetron of the – 5th century. National Museum, Athens, reproduced from Brandt (1), vol. I, p. 84, Abb. 97; p. 83, Abb. 96.

exclude the probability that it was known in other Mediterranean regions too (Fig. 14).

The history of the onos deserves a few remarks. Before the first decade of our century, nobody could say what this 'tile' was for.[a] The spinning method has, with one exception, been lost in Europe for several centuries or even for two millennia. It was the scholar F. M. Feldhaus who was the first to discover that this tile-shaped instrument was not only used in ancient Greece but also in early 19th century China, as is shown in a picture by Pu Qua, dated + 1801 (Fig. 15). The Bibliothèque Nationale in Paris has another 19th century illustration documenting the use of such a tile-shaped instrument. It belongs to a series of twelve sketches (Fig. 16). Hommel explains its use in 20th century China:[b] 'Itinerant cobblers on the street, and sometimes women in the country (I do not forget the one in Kien Chang, Kiangsi, who would not sell me the beautiful green glazed tile of the Ming dynasty, as it fitted her thigh so snugly), place a roofing tile upon their thighs, and twist the yarn upon this, others, to save their clothing, roll up their trousers and twist the fibres upon the bare leg.' Such roof tiles in

[a] **Lang (1); Feldhaus (2), p. 45, fig. 47; p. 117. Feldhaus (1), p. 758.**
[b] **Hommel (1), p. 169.**

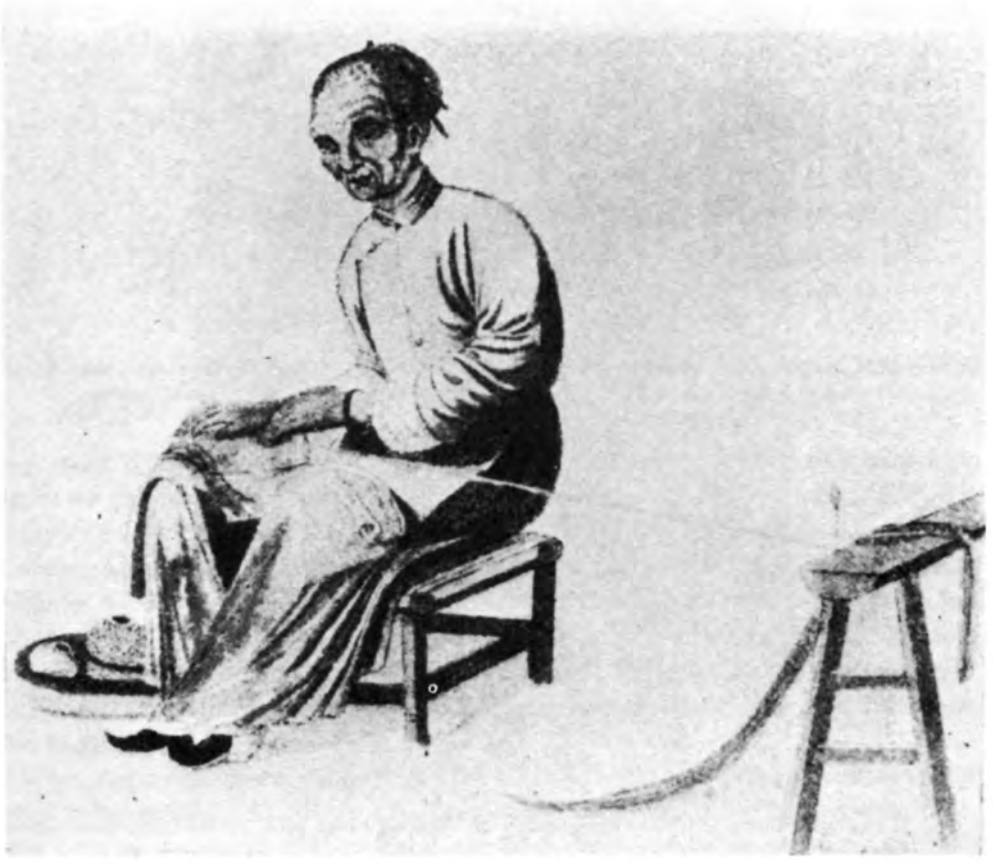


Fig. 15. Tile-shaped instrument used as an epinetron, Canton, +1801. Picture by Pu Qua, reproduced from Feldhaus (2), p. 45, Abb. 47.

fragmentary condition were excavated from Chou dated sites in Kho-sheng-chuang, near Sian, Li-chia-tshun in Mi-hsien, and Chhen-chia-tshun in Fu-feng.[a] The tiles were made of common fine clay highly tempered with sand and stamped with cord-marks. They are hard in texture, having been baked at a high temperature, and there were two types : one was flat, the other semi-cylindrical.[b] The semi-cylindrical tile was the type used as an epinetron in China (Fig. 17).

Traditionally the Chinese character *wa*[1] was understood as spindle-whorl[c] or as a weight for the spindle, an expression which paraphrases the whorl.[d] But we should now like to produce a hypothesis explaining *wa* as a tile, the first meaning of the character.

a Cheng (19), p. 17.
" Anon. *{636)*, p. 490, fig. 13: 7; fig. 23: 7.
[0] See Karlgren (14), p. 131, no. 189 'spinning whorls'.
<i Giles (1), no. 12, 420.



Fig. 16. Tile-shaped instrument used as an epinetron. Making hemp yarn (*tso ma-hsien*), south China, 19th century. Industrie du ma, 19th century, Bibliothèque Nationale, Paris (Oe 92, pl. 7).

And so he bears daughters; they lay them on the ground, they dress them in wrappers, they give them as toys earthenware tiles...[a]

A tile used as a spindle-weight would only make sense if it had been of the cross-bar spindle type, but as far as we know, cross-bar spindles were made of wood or bone, not of pottery. Furthermore, if it had been a sort of spindle-weight, its use in an agricultural society would not have completely disappeared, and archaeological evidence would be available. Hence the *wa* may have fulfilled the same technical function as the epinetron or onos, namely to roll fibres. In China the 'tile' was not used to produce the roving, as was done in Greece, which was mainly wool-producing, but it did help to perform the splicing of ramie and hemp fibres. In this technical context, the use of the 'tile' makes sense. Tsou Ching-Heng, who discussed[b] all the major Chinese sources on the *wa*, and who provided all the

[a] Translation is based on Karlgren (14), no. 189. Hsia Nai does not follow our interpretation of the *'wa'*, but prefers the traditional view that it means a whorl. He concedes, however, that there is a possibility that *'wa'* could have meant a tile-shaped instrument used in spinning. (Private correspondence, 16 June 1984.)

[b] Tsou Ching-Heng *(¢)*, pp. 211-22.

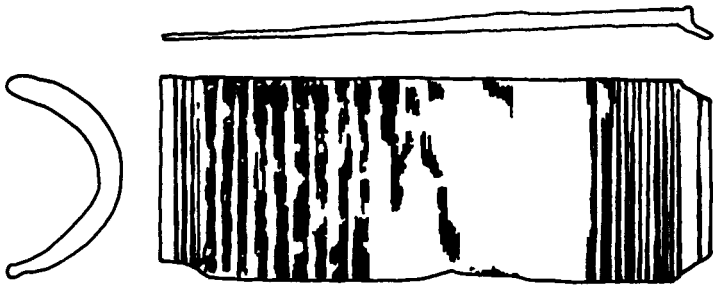


Fig. 17. Semi-cylindrical tile *thung-wa* 筒瓦, which could have been used as an epinetron, Hopei, —3rd century. Anon. (*759*), p. 48, fig. 22: 5 (redrawn from the small picture published; scale 1: 6).

important references (which need not be repeated here), reports one exception where *wa* cannot be understood as 'spindle-whorl' but has to be named 'tile'. He provides a 20th century reference telling us that in the region of Miao-li in Taiwan a woman used such an implement to hew hemp to make yarn of it. From the little evidence we have, we may conclude that the 'tile' was known in early China but was replaced by better technologies in course of time, to the effect that it could only be found in southern parts of China. Obviously the implement was employed for two tasks, hewing the fibres and rolling them after splicing, to try their firmness and to give them evenness.

When approaching spinning technology in the real sense of hand-spinning, we reach safer ground. As mentioned previously, long-staple fibres may originally have been spliced and rolled by hand, the yarn produced being stored by winding on to a stick.[8] Such a stick may have had a length of between *c.* 22 and 37.5 cm, with round or tapering ends. The spinner wound the yarn around the stick by holding it in a horizontal position and turning it around. After winding, a loop was tied to prevent the yarn from loosening and untwisting, a method which may have led to trying a stick with a groove or hook to help fasten the yarn more securely. In this case, the prepared hand-rolled roving—an assemblage of fibres in rope form without twist - was tied with a loop to the hook of the spindle. After that spinning could start. The left hand held the end of the roving between thumb, forefinger and middle finger and controlled the feeding of the yarn to die spindle, which was rotated by the right hand. In such a way the left hand drew out the yarn, pulling out the short-staple fibres parallel in a lengthwise direction. The

[a] For detailed studies on the subject see: Krause (i), p. 199; Ehrenreich (i), vol. 2, p. 21; Götze (1), p. 473; Söckeland (1), pp. 95-6; Schulenburg (1), pp. 168-9; Blümner (1), vol. 1, pp. 113-15; Finsch (2), p. 372; Frödin and Nordenskiöld (1), p. 77; Koch-Grünberg (1), vol. 3, pi. 58; Neuburger (1), p. 171; Orth (i), pp. 61-8; La Baume (1), pp. 71-3; Horwitz (5), pp. 111-19; Parish (1), pp. 567-70; Nevermann (1), pp. 68-79; Horwitz (14), pp. 1782-1808; La Baume (2), pp. 2-4; Hentschel (1); Crowfoot (1), pp. 424, 425; p. 433, fig. 273; La Baume (3), pp. 31-9; Forbes (13), vol. 4, pp. 152-67; Linder (1), pp. 50-60.

attenuation and twisting followed each other continuously, otherwise the quality of the yarn became rather uneven and knotty. As soon as the spinner had finished a certain length of yarn, it was wound on to the spindle-rod.[a] With long-staple fibres it may have been different because drawing-out was not needed; the quality of the yarn having already been determined at the completion of splicing. In such cases yarns were only spun to put a twist into them.

This simple stick-spinning device is rather difficult to work and, from an economic point of view, is not very efficient; people may, therefore, have experimented with the spindle-rod to improve its spinning properties. Finally, they must have realised that it lacked the weight necessary for easier and faster rotation, so they attached something heavy to it. And so it came about that a weight, normally a disc-shaped fiat and round whorl, made of bone, wood, stone or clay, acted as a revolving mass like a flywheel. The whorl had a hole perforated in its centre to fix it to the spindle-rod. The hand-spindle, which is defined as a spindle to which a whorl is attached, acting as a revolving mass, had been invented. Its operation, with the spun yarn wound round it, enabled the fibres to be drawn out more easily, and the necessary twist given within a specific length.[1]» This whole operation of the hand-spindle is normally called spinning.[0]

Without question the hand-spindle should be considered as the most important invention ever made in the field of spinning technology. It constitutes an outstanding technological and cultural achievement of neolithic times, a 'revolution' in textile manufacture, a complete change in yarn production. Yet the change in yarn production did not cause a change in neolithic societies, hence the use of quotation marks round the word revolution. Indeed, attention should be drawn to Fernand Braudel's remark:[4]

> Not only the rapid changes we are a little too ready to label revolutions (…) but also the slow improvements in processes and tools, and those innumerable actions which may have no immediate innovating significance but which are the fruit of accumulated knowledge.

For the first time in the history of mankind, people were able to produce a continuous yarn of equal fineness in strength and diameter. The spindle-whorl made it possible to produce yarn of various qualities, to obtain strong yarns of high elasticity, and to increase production immensely. Furthermore, with the help of the new spinning device the twisting technique improved, and the doubling

» It is of interest to note that a stick as spinning device is still in use in the Chicama valley in Peru and other regions of South America; see Horwitz (5), pp. 111-19; La Baume (3), pp. 31-3; Hentschel (1), pp. 24-8; Linder (1), p. 53; Hawkes (1), p. 312.

[b] Hentschel (1), p. 30; *GTL*, vol. i, p. 567.

[c] Forbes (13), vol. 4, p. 150; Crowfoot (1), p. 424; Emery (1), p. 9. A very simplified description of spinning is given by Hooper (1), pp. 633-4; pi. 2 shows spinning implements.

[4] Braudel (2), p. 334.

technique in which two or more yarns are combined by twisting them together was developed.

(i) *Spinning with Hand-Spindles in the Neolithic Age Outside China*

Usually, there are two possible ways of showing that spinning techniques were used in neolithic cultures, either by finding spindle-whorls, or actual spun yarn, mostly woven into fabrics.

Stone spindle-whorls were found in Telailät Ghassül, Palestine, dated about —3000,° small and convex limestone spindle-whorls were discovered in Naqada, Egypt, from about the same time,[b] while the first settlement of Troy, also dated about —3000,[0] and the second settlement some 500 years later,[d] yielded about 8,000 examples made of clay. The earliest European spindle-whorls, made of stone, are from the lake-dwellings at Bielersee in Switzerland which may be dated as being from the middle of the —3rd millennium.[6] Bone, limestone, alabaster and basalt spindle-whorls excavated at Meggido,' Palestine, date from before —3300 (stratum XX) to about —1050 or —1100 (stratum V).

The early sites of Jericho and Jarmo, where the earliest strata may well go back to the —8th millennium, provide no certain evidence of the application of spinning and weaving,[8] and until about twenty years ago, the woven fabrics from the Fayum in Egypt, dated as being from the —5Ü1 millennium,[11] were considered the earliest textiles. Since the excavations of Catal Hüyük in 1961, we can 'push the history of the textile arts back to the beginning of the —6th millennium'.[1] The textile finds in level VI are thoroughly carbonised, but as Burnham remarked ' all the yarns are well and evenly spun, showing the fibres to have been carefully prepared'.[3] He thus arrived at the conclusion that 'the textile tools of Catal Hüyük were undoubtedly of wood, and no recognizable trace has survived. In view of our knowledge of the extended distribution of the dropped spindle throughout the Near East in later periods, it seems likely that this was the tool employed for spinning.'[k] The raw material of the fabrics was identified as flax.[1]

» Mallon, Koeppel and Neuville (1), vol. 1, pis. 35, 36; Crowfoot (1), p. 433, fig. 273A.

» Pétrie (6), p. 41, pi. XXVI; Pétrie (1), p. 53, pi. LXVI; Crowfoot (1), p. 433, fig. 273B.

[c] Biegen and Caskey (1), vol. 1: 2, pis. 366-8 'decorated whorls'; Crowfoot (1), p. 433, fig. 273C.

[d] More whorls are published by Biegen (1) in the volumes on Troy (fourth settlement, 1951), vol. 2: 2, pis. 151-3; Troy (sixth settlement, 1953), vol. 3: 2, pi. 296; Troy (eighth settlement, 1958), vol. 4: 2, pi. 289. Crowfoot (1), p. 433, fig. 273E, F ; for a good impression on the variety of whorls found, see Schliemann (1), pis. XXI-LI.

[e] Vogt (1), p. 48; Crowfoot (1), p. 435. For spindle-whorls we may refer to: Ohnefalsch-Richter (1), pp. 298-300, fig. 20; Stokar (1); La Baume (3); Bosch (1). A synopsis on Scandinavian material is given in Mon tell (4), pp. 110-11; see also Sirelius (1); Lithberg (1); Jirlow (1).

' Loud (1), vol. plates, nos. 171-2; Crowfoot (1), p. 433, fig. 273D.

* Clark and Piggott (1), pp. 152, 154, 157-9; Hawkes and Woolley (1), p. 313.

* Caton-Thompson and Gardner (1), pi. 28.

[1] Burnham (3), p. 169. [J] *Ibid.*, p. 170. * *Ibid.*, p. 173.

[1] Ryder (1), pp. 175-6; earlier research on textile material was executed and published by Helbaek (1), PP- 39-46- Among the fragments Helbaek found was one piece which could have been made of wool.

It is surprising that no spindle-whorls have been found and there is no evidence that the people of Catal Hüyük grew flax or kept domestic sheep or goats.[a] For this reason Mellaart concluded 'that cloth was an import',[b] and we shall have to wait for future excavations to clarify the problem of textile production there.

The site of Susa I in Mesopotamia which may be dated as being at least from the early —4th millennium, yielded traces of linen with S-spun yarns in warp and weft.[c] In addition, a fragment of linen with Z-plyed threads was found at Sialk in Iran,[d] and scraps of cotton textiles were excavated at Mohenjo-Daro, dated as before — 2300 or even as early as — 3000.[6]

All these finds attest to the use of the spindle-whorl in various regions of the world in the neolithic age. Indeed, just recently, a profound and competent study by Wolfgang Wickler and Uta Seibt on the iconography of South American spindle-whorls from Ecuador has been published. It takes a lead in a hitherto unexplored direction in its research into simple objects of material culture.'

(ii) *Hand-Spindles, Their Working Methods and Efficiency Inside and Outside China*

We do not know which spinning methods the Chinese people used to produce yarn, so we have to rely on the information and material provided from other contemporary cultures. From the pictures in the Egyptian tombs at Beni Hasan of the 12th dynasty *(c.* —2000 to — 1770), we have learned of several spinning methods with the hand-spindle:[g]

1. *The grasped spindle-spinning method*

   A rove, placed in a basket, is passed through a ring or over a fork and is spun on a large spindle. The whorl is grasped and rotated in both hands. This operation produces a coarse, uneven yarn.

2. *The supported spindle or the spindle rolled on the thigh method*

   The drawing-out of die fibres is done between the hands, the twist being put into the yarn by rolling the spindle on the thigh; this method is a direct forerunner of the next method 3.

[8] **Mellaart (3), p. 105. This problem appears to be difficult to solve because finds of bones suggest that sheep were present. Furthermore, there were ràm's heads in shrines, see Mellaart (2) (196a), p. 56; (1964), PP- 57> 66> 73- See also Perkins, Jr. (1), pp. 177-9**

[b] **Mellaart (3), p. 105.**

[0] **De Morgan (1), vol. 3, p. 52; Crowfoot (1), p. 432; Forbes (13), vol. 4, p. 160.**

[a] **Pfister (3), vol. 2, p. XXXII: 13; Crowfoot (1), p. 432; Hawkes and Woolley (i), p. 314.**

[e] **Marshall (4), vol. 2, p. 585; Crowfoot (i), p. 432; Bray (i), pp. 536-7.**

[' **Wickler, Seibt (1), pp. 315-419.**

[g] **Material on the subject can be found in Calliand (1), pi. 17a; Schliemann (2), p. 294, fig. 139a 'Beni Hasan'; Newberry (1), vol. 2, pi. 4: 13 (tomb no. 15, main chamber, north wall); Klebs (1), p. 125; Crowfoot (1), p. 438, fig. 276, tomb of Khety Beni Hasan, Egypt, *c.* — 1900; Forbes (13), vol. 4, p. 158, fig. 13; Montell (3), p. no; Linder (1), fig. 1. From the nth dynasty (— 2100 to —2000) we know of the models found in the tomb of Nehenkwetre at Thebes, now in the Metropolitan Museum, New York and in the Liverpool Museum: Davies (1), p. XXXVII; Davies (2), vol. 1: 2, p. 234, fig. 1; Forbes (13), vol. 4, p. 158, fig. 28.**

3. *The suspended spindle-spinning method*

The fibres, which could be arranged on the distaff or placed in a basket, are drawn out, fastened to the spindle and caught under a hook. The feeding is done regularly while the spindle rotates. Rotation is done by hand; the spindle is dropped and thereafter allowed to swing. This free-flying spindle-spinning method used the increased momentum of the revolving mass of the whorl, and in this way a fine, even yarn of some strength is obtained.

Such spinning using a suspended or dropped spindle was known in Mediterranean antiquity as can be seen from pictures on vases.[a] It was commonly applied in Medieval and Renaissance Europe.[1]* (Fig. 18; Fig. 19). Indeed, spinning chambers were quite common in Europe; an early woodcut of +1524 by Barthel Beham, a Nuremberg artist, who was expelled from Nuremberg because of anarchistic and atheistic views, gives a vivid impression of the activities taking place in such workshops (Fig. 22).° There is nothing comparable to it in China. It is still used in Africa, South America, parts of Europe and Asia[d] (Fig. 20; Fig. 21), though sometimes the method is slightly modified and appears as 'spinning in the bowl', which means that the spindle rotates on a saucer or in a bowl[6] (Fig. 23 ; Fig. 24). It is obvious, of course, that spindles could be used for the working processes of twisting and doubling.

The working quality of the hand-spindle does not depend on the material of which it is made, but on the symmetrical shape of the whorl and the vertical perforations being exactly at its centre, otherwise it will wobble and reduce the quality of the yarn. Such observations are valid for the round whorl, but besides the disc-shaped spindle-whorl (Fig. 25), there is another type, the crossbar spindle (Fig. 26) ; it was probably an early invention too. So far we have no archaeological evidence and must rely completely on an early + 14th century description and illustration and on material from this century.' The crossbar spindle is a square, made of wood, stone or bone, about 13 to 19 cm long and between 4.5 and about 9 cm thick. It is pierced by a hook, made of wood or a bent nail. Such a spindle has to be regarded as a working unit as was the case with the hand-spindle made from one piece of wood or metal.[8]

A sample of a one-piece wooden hand-spindle *(fang-hsien mu-ting[1])* has been

» **Blümner (1), vol. 1, pp. 132-3; Crowfoot (1), p. 444, fig. 281; Forbes (13), p. 162, fig. 15; p. 163, fig. 16; Wild (1), pp. 31-40.**

» **See Brandt (1).**

[0] **Geisberg (1), vol. 1, p. 133: G 154.**

[A] Linder **(1),** fig. 10 (north Camerun); fig. 13 (Tibet); fig. 14 (Peru); fig. 9 (Nepal).

[e] **Crowfoot (2), p. 19, type 5 B.**

' *NS,* ch. 22, **p.** i6ab; JV5 (+ 1530), ch. 26, pp. isab; see also *NCCS,* ch. 36, pp. 23ab; *STTH, (chhi-yung),* ch. 9, p. 10b; Hommel (i), p. 167, fig. 244; p. 168, figs. 245, 246; Montell (3), p. 113, fig. 2; **p.** 114, fig. 3; pi. **I:** 4; p. **115, pi. III.**

« **Forbes (13), vol. 4, p. 153; Linder (1), p. 55. [fi]g- 5°: [6]-**

[1] 紡綫木錠



Fig. 18. When Adam delved and Eve span, +1340. Yerislaw Bible (Mansell Collection), reproduced from Power (1), p. 12, fig. 1.

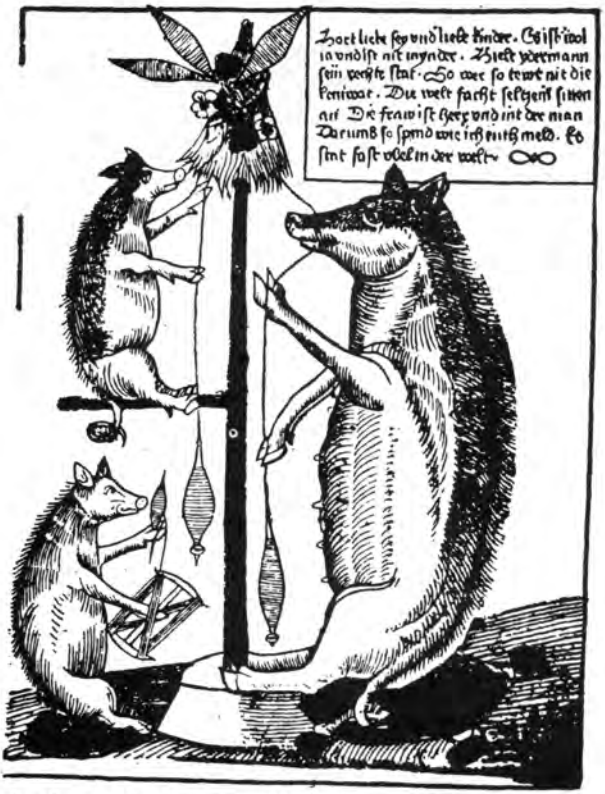


Fig. 19. Spinning from a fixed distaff, a Nuremberg symbolic woodcut, *c.* +1490. Nationalbibliothek Wien, reproduced from Brandt (1), vol. I, p. 168, Abb. 226.



Fig. 20. Chinese peasant woman spinning cotton yarn, Kansu province, 20th century. Photograph by J. G. Andersson, reproduced from Montell (4), pl. IV: 1.



Fig. 21. Chinese peasant spinning, Hsi-ning-ho in Kansu province, 20th century. Photograph by J. G. Andersson, reproduced from Montell (4), pl. IV: 2.



Fig. 22. The spinning chamber; woodcut by Barthel Beham, + 1524. Geisberg (1), vol. I, p. 133: G 154.

excavated from the Han site of Mo-tsui-tzu ' in Kansu.[a] Another one-piece hand-spindle with an iron shaft dating from the time of the Three Kingdoms was found in Phing-pa[2] in Kueichou.[b]

The *Ming Shu* tells us :°

The revolving mallet spindle *(hsiian-chhuP)* (Fig. 27) is a suspended implement (for making) hemp fibres into coarse yarn *(phi*).*[d]

It is cut from a piece of wood with a length of about 19 cm and a diameter at its ends of some 9 cm or more. Between both ends it is finely cut like a drum at its waist.[6] In its centre is a small hole in which a hook with a length of 12 cm is inserted. The hook is attached to the hemp bast so that the spindle hangs down from it. With the left hand the spindle is suspended, the right hand revolves it, causing the hemp to get (corded) tightly. (When the (cord) is long enough), then it is wound around the mallet spindle. The remaining hemp is seized on the hook and the cording starts again as before. The

*** Anon, (ffpfi), p. 24; pi. 4: 11 (tomb no. 22).**

b Anon. *(706)*, p. 210, fig. 4: 7. [c] **AS, ch. 22, pp. i6ab.**

a *Tiao*[5] translated as 'suspended', should be understood as the meaning of the character *tiaof>,* **see** Giles (i), no. n. 060. *Phi*,* also pronounced *pet* we have translated in the sense of *phi*[1], to work fibres **into thread for weaving, see Giles (i), no. 9024.**

[e] **Hsia Nai renders the sentence differently : ' Between the two ends the centre of the mallet is cut thinner like a waist drum in shape.' An ancient type of** Chinese **drum was just such a shape. (Private correspondence, 16 June 1984.)**

[1] 磨咀子 [2] 平壩 [3] 旋椎 [4] 紱 [5] 掉
[6] 弔 [7] 繃



Fig. 23. Spinning ramie thread in a bowl, Kyōto, +1723. The description of the working-step reads *o tsumugu*. In our opinion the *kanji* 苧 has to be read *karamushi*. That ramie is being spun may also be seen from the spliced fibre material contained in a pot. *Hyakunin Jorō*, +1723.

warp and weft threads produced in this way can be used to make coarse cloth or to weave shoes. People in the countryside all do it in their leisure time. Although the mallet spindle belongs among the trivial implements, it is decidedly helpful for the poor country-people.

The poem says:

> The hook of the spindle, suspended empty, is raised high,
> the hemp corded tightly so as to make the hempen threads for the cloth,
> recently apt people from the countryside have changed its use,
> they spin woollen threads to manufacture woollen mats.

Hommel described the spinning with the mallet spindle as follows:[a] 'In using this spindle, the yarn is started by rolling the fibres between the fingers, or upon the upper part of the leg, then the twist thus fashioned is fastened to the hook of the spindle. The spindle hangs free and is set spinning by taking the hook between

* Hommel (i), pp. 165-6.



Fig. 24. Spinning bast fibre yarn, Japan, *c.* +1170. Maeda Yukichika (*1*). *Shigisan Engi Emaki;* see Armbruster (1), p. 287.

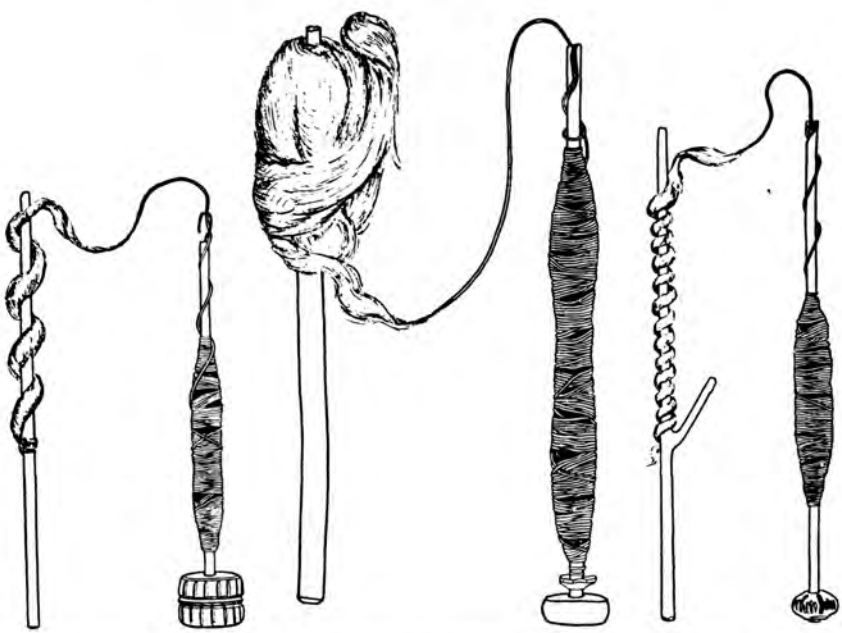
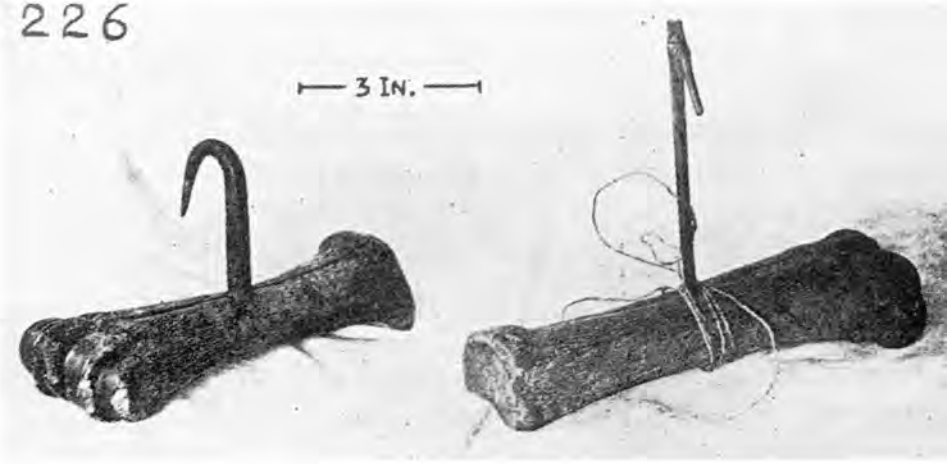


Fig. 25. Chinese spindles with distaff, Kansu province, 20th century. J. G. Andersson Collection, Museum of Far Eastern Antiquities, Stockholm reproduced from Montell (4), p. 119, fig. 8 (scale 1:5.8).



旋椎

旋平聲椎掉麻紵具也截木長可六寸頭徑三寸許兩開斫細樣如腰鼓中作小竅插一鉤簨長可四寸用繫麻皮於下以左手懸之右手撥旋麻既成緊去聲就纏椎上餘麻挽於鉤內復續之如前所成經緯可作麤布亦可織履農隙時老稚皆能作此雖係瑣細之具然於貧民

Fig. 27. Mallet spindle (*hsüan-chhui*), +1313. *NS* (+1530 ed.), ch. 26, p. 15a.

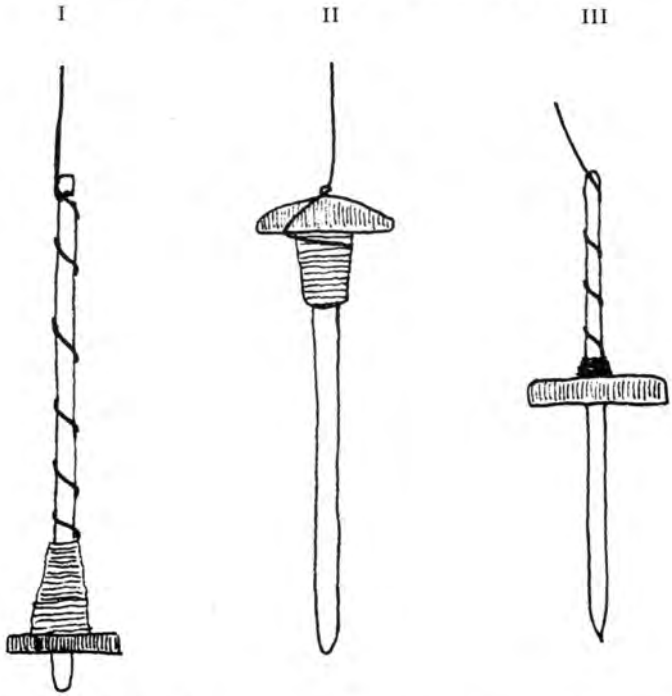


Fig. 28. Three types of hand-spindles: I, Low-whorl spindle; II, High-whorl spindle; III, Middle-whorl spindle.

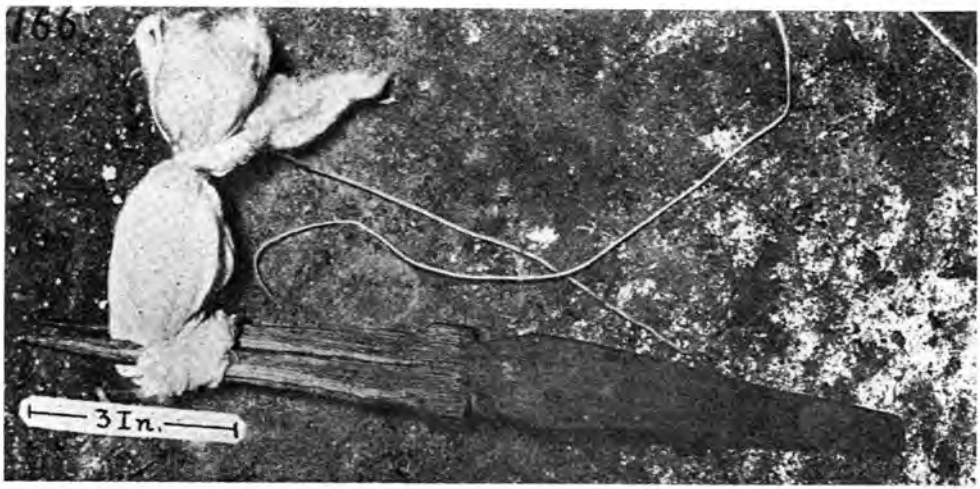


Fig. 29. Distaff, Shanghai area, 20th century. Hommel (1), p. 169, fig. 247.

thumb and forefinger of the right hand and giving it a twirl. The material, be it silk, hemp or cotton roving, is then fed into the twirling twist and when the spun yarn gets so long that the spindle almost touches the ground, the spinner winds it upon the base of the spindle, passes the end up under the barb of the hook and resumes spinning. The spinners sit or stand when using the spindle....'

During the 20th century in China, this heavy spindle has obviously been used to spin all sorts of fibre into coarse yarn. In Wang Chen's time only very coarse yarn, or more probably cords, were manufactured with this implement, otherwise he would not have discussed it in his section on rope-making.

Hand-spindles can be recognised by the position of the whorl on the spindle-rod. Montell defined the two main types:[a] 'The term high-whorl spindle is used to denote the type of spindle the whorl of which is placed above the middle of the spindle-rod. A low-whorl spindle is thus one whose whorl is placed below the middle of the spindle-rod' (Fig. 28).

The distaff *(chha[1])*, another implement always used in the spinning process, should be mentioned[b] (Fig. 29). It is a long stick which holds the material to be spun, and could be shaped in various ways.[0] Usually it had a length of about 30 to 90 cm and, while spinning, was held under the left arm (presupposing the spinner was right-handed). It appears to have originated in the Mediterranean area,[d] though its use in China is documented by a picture from Han times illustrating it at work.[6] When long-staple bast fibres had to be spun (twisted), a distaff was superfluous because a continuous yarn had already been produced by the splicing process. Hence the distaff came into play only for short-staple fibres such as wool, waste silk, short cut bast fibres and cotton.

(a) *A Short Excursion into the Processing of Waste Silk*

Now it seems appropriate to say a few words about the Chinese hand-spindle in action and the material spun with it. We have learned how bast fibres had to be processed prior to splicing and 'spinning', but the only descriptions of spinning with the hand-spindle come in the context of Chinese silk technology. Here the predilection of Chinese literati for silk is obvious. Hence we have to consider evidence on the processing of waste silk so as to make presuppositions about the spinning process easier and more readily understandable (Fig. 30).

Generally, silk is reeled straight from the cocoon and need not be spun. Only inferior quality silk was taken as wadding or to be spun as yarn for weaving, mostly in the form of weft or for embroidery work. Such silk came from the beginnings and ends of the silk threads which could not be reeled, from damaged

» **Montell** (3), p. no, n. 1.
[b] *NS* (+1530), ch. 25, pp. 3ab.
[c] Kimakowicz-Winnicki (1), p. 13, Abb. 17-24; Linder (1), p. 31, fig. 27; Hommel (i), p. 169, fig. **247;** Montell (3), p. 119, fig. 8; p. 121, fig. 10; pi. 4: 1 + 2.
[d] Blümner (1), vol. 1, p. 132, figs. 47-9; p. 133, figs. 50-2.
[e] See below, Fig. 123.

[1] 叉

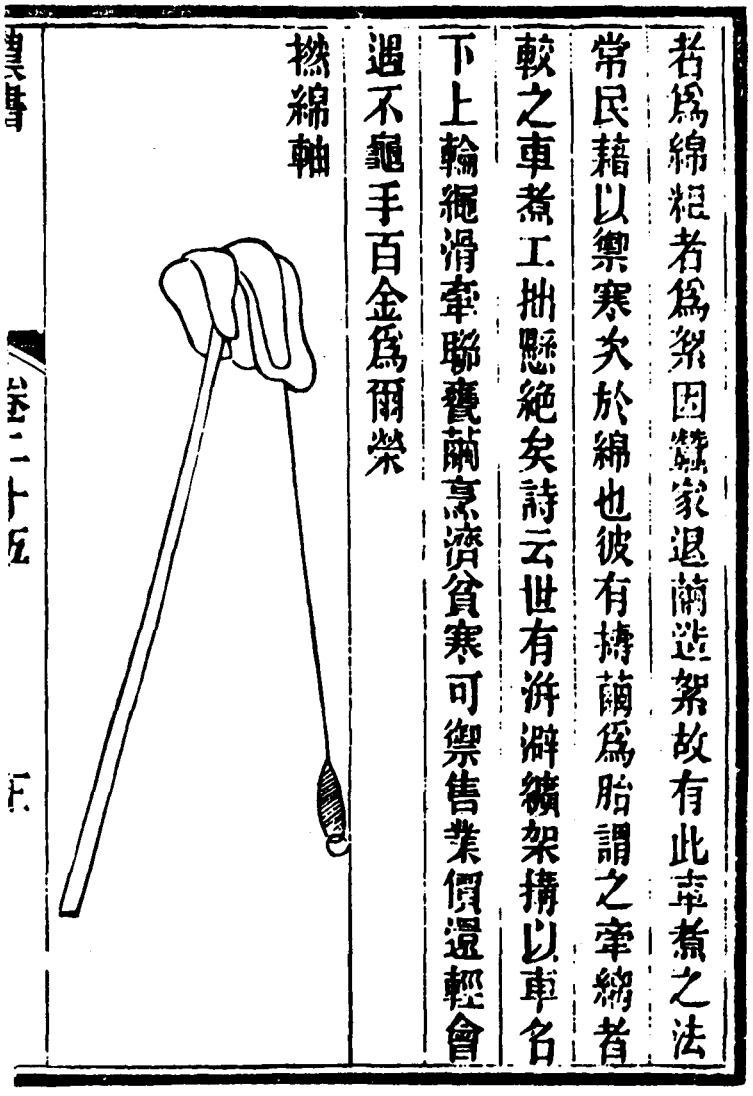


Fig. 30. Waste silk spinning spindle (*nien-mien-chou*), + 1313. *NS* (+ 1530 ed.), ch. 25, p. 3a (the text on the right side belongs to the *hsü-chhe*, waste silk frame).

cocoons or cocoons which were too small for reeling, as well as from so-called neri cocoons of dead moths, cocoons which were spotted, and cocoon remnants left in the reeling-pan after reeling *(kuo-ti-mien*[1]*).*

Apart from the advanced treadle-spinning method—which will be discussed below[B]—there was also the dry-spinning of waste silk, using the suspended spindle

* **Spinning generally, and silk-spinning with the treadle-operated wheel, will be discussed below, see ch. (</), (i), (iii), *a*.**

[1] 鍋底綿

spinning method described and illustrated in the *Nung Shu* and other agricultural and encyclopaedic works.[8.] The *Nung Shu* says:[b]

[A description of] the spindle for spinning waste silk *(nien-mien-chou[1]).* (It has) a small whorl *(hsiao-tho[2])* either of wood or of stone (attached to it). The fine spindle-shaft has a length of about 30 cm and (its lower end) is inserted in the whorl. First the waste silk is put on top of the distaff *(chha[3])* which the spinner holds in her left hand. The right hand draws[0] the waste silk out and the spindle-shaft hangs down from it. When the waste silk yarn has been spun (caused by the rotation of the spindle) then the yarn is wound around the spindle-shaft, and now a fine yarn is produced. (This method) was employed by the women of the inner apartments. One can use this method instead of spinning (with the spindle-wheel).

The result of hand-spindle spinning was a fine silk yarn *mien-chhou[4],* which was used for the weft because it had a bright lustre and was durable. We may conclude from the description that the twisting direction of the yarn was clockwise, which puts a Z-twist into the yarn, assuming that the hand-spindle was driven with the thumb, and the first finger or middle finger of the right hand. We must now consider how the silk had to be prepared before spinning.

Chuang Tzu (about — 300) makes a short reference to the treatment of waste silk, calling it 'washing the waste *silk' phingphi khuang[sA]* though this was only one task in its processing; it was explained as floating the waste silk *(fu phiao hsii[6]).*

In ancient times, as Wang Chen says, *khuang-hsü[7]* and *mien** were the same.[e] But in his time, the fine waste silk which could be spun was called *mien,* and the coarse quality, *hsii,* was mainly used as wadding material in winter garments.' We are concerned with that used for spinning, of which the *Pin Feng Kuang I[e]* (Enlarged Explanations of the Sericultural Crafts of Pin) provides reliable information.

In the boiling technique *(mien chien cheng fa[9])* waste silk cocoons were used. These were popularly called 'moth-void' *(e-khung-tzu[10])* because the moth had already broken out, destroying the continuous thread and leaving behind the empty cocoon which could no longer be reeled off; spotted cocoons (with dead silkworms inside) *(hsieh-tshan-chien[li]),* the 'bleeding silkworm cocoon', were also boiled. The worker put the cocoons into warm water and let them soak for one day; then he took them out and washed them in clear water. After washing he or she arranged them on a sieve, hanging it into water enriched with sodium carbonate

[a] *NS,* ch. 2i, pp. 24.b-25a; *NS* (+1530), ch. 25, pp. 3ab; *STTH, (chhi-yung),* **ch.** 9, pp. 6ab; *NCCS,* ch. 34, pp. I7ab; all these texts are based on the *NS* text. *TSCT,* ch. *thu-shuo,* **pp.** 6b—7a.

[b] JVS (+1530), ch. 25, pp. 3ab.

[c] **The Chinese text has *yin'[2]* which we translated as 'drawing out'. But we can use also the character *chhe[11],* used in Chhing times, *PFKI,* ch. 3, p. 4a.**

[d] ***Chuang Tzu Pu Cheng,* ch. 1 *shang,* p. 19a.** [e] ***NS,* ch. 21, pp. 24a.**

' Most waste silk was used for the production of wadding. Though ordinary people may have had cotton wadded garments to withstand the cold in winter, only the rich could afford silk padded jackets and coats.

« *PFKI,* ch. 3, pp. $_4$a-$_5$b.

[1] 撚綿軸 [2] 小碢 [3] 叉 [4] 綿紬 [5] 汧澼絖
[6] 浮漂絮 [7] 纊絮 [8] 綿 [9] 綿藏蒸法 [10] 蛾空子
[11] 血蠶藏 [12] 引 [13] 扯



Fig. 31. The pulley frame for boiling waste silk (*chu-hsü hua-chhe*), +1313. *NS* (+1530 ed.), ch. 25, pp. 2ab.

or natron *(chien*[1]*)* and boiled them several times, filtering the carbonate-water between each boiling process. Finally, the worker uses his fingers to test whether the silk threads are loose or not. Next the cocoons are placed in a sieve and steamed. If they are not steamed thoroughly, they remain raw and very difficult to spin, but if steamed too long, the silk rots and loses its strength. After removing them from the sieve with chopsticks they are cleaned once more in warm water; then they are ready for the wet-spinning method. If, however, the steaming is continued too long and spinning is not possible, or if the worker fears that the silk will rot and become worthless, the cocoons are left to dry in the sun; after this they are soaked in water once more, then dried again. They are always stored between soaking and drying, so the silk may finally be ready for spinning.

The preparation of fibre to be spun by the dry-spinning method is almost identical. The cocoons are boiled in carbonate-water for two hours and afterwards cleaned in clear water, dried in the sun and stored. Afterwards they need stretching *(chang*[2]*)* before being put on the fork-like distaff.

Normally fibre preparation is described under the heading 'waste silk frame' *hsü-chke*** (Fig. 31). This frame was made of wooden posts with a hook fixed to a

[a] *NS*, ch 21, p. 24a. JVS (+1530), ch. 25, pp. 2a~3a. *STTH, (chhi-yung)*, ch. 9, p. 39b. *NCCS*, ch. 34, p. 17a. *SSTK*, ch. 75, p. 20b. *TSTP*, ch. 11, p. 52a.

[1] 鹼 [2] 張 [3] 絮車

rope which went around a pulley *(hua-chhe[1])* placed just under the point where the three or sometimes four posts were joined. A hot-water pot for boiling the cocoons *(chu chien thang-weng[2])* was placed just under the hook. The cocoons hung on the hook were always moved up and down into the hot water enriched with rice-stalk ashes,[a] *tao-kao-hui[3]*, with the result that the silk threads gradually became one soft lump of waste silk, *hsu-tuan[4]*.

This boiling process, called 'cooking soft' *(shu-lien[5])*[h] in the *Thien Kung Khai Wu*, was necessary to remove the gum from the silk fibres so that the material was in a suitable condition for spinning. This method, using a strong wash temperature of about 80 °C, and always keeping the material moving, resulted in a loss of weight of about 20 per cent.

From this short abstract derived from a number of texts it is possible to imagine how many different, and at present unknown methods of degumming silk were used in China. Although the manufacture of waste silk for spinning had to be executed by hand and was certainly very labour-intensive, such general processing still has to be done today, otherwise the silk cannot be spun.

(iii) *The Importance of the Weight of Spindle-whorls*

The sizes, shapes and weights of spindle-whorls and the length of the spindle-rods always depended on the fineness and strength of the fibre being spun into yarn. For example, light wooden whorls were used to produce woollen yarns, heavier whorls such as those of stone, for flax and the like.[0] Heavier whorls were also used for doubling yarns into thread.

To demonstrate this, we may refer to the research work of Alfred Linder,[d] who investigated the spinning qualities of neolithic spindle-whorls found in Switzerland and of others used in Europe and South America. He claimed that a light spindle-whorl of 9 g, made of stone, was more suitable to double two fine yarns into a fine thread than a heavier one of the same material with a weight of 27 g. In the first case the frequency of rotation was 2800 times a minute, in the second only 1800 times. The discovery of even smaller whorls of 5 to 7 g allows us to conclude that they were used for very fine yarns.

The higher the number of rotations, the better the tensile strength of the yarn.

There is also a relationship between weight of whorl, frequency of rotation and working efficiency. If a spindle-whorl weighing 4 g is used and a yarn of Nm 170 is to be spun[6] with a twist of 1200 turns per metre and a frequency of rotation of

» *TKKW*, ch. 2, p. 19a. [b] *Ibid.*

[c] Forbes (13), vol. 4, pp. 152-3.

[d] Linder (1), pp. 50-60; see also Bohnsack (1), pp. 57-61.

[e] Here we use the metric system, expressed in Nm, which is defined as metre/gram, see *GTL*, vol. 2, pp. 121-2. In England several systems are applied, depending on the raw material.

[1] 滑車 [2] 煮繭湯鬠 [3] 稻藁灰 [4] 絮段 [5] 熟練

3000 per minute, we get an output of about 112 m of spun yarn in one hour or, to put it differently, 0.49 g per hour. A spindle-whorl weighing 20 g producing a yarn of Nm 17 with a frequency of rotation of 2100 per minute, may spin about 167 m or iog per hour. The one hour's working time includes winding the spun yarn round the spindle-rod. These results represent practical, not theoretical, figures of average efficiency.[a] When using spindles of 6 to 12 g, it is necessary to turn them at least twice per metre. Assuming it is empty to begin with, a bigger spindle has a longer run when turned once, but its frequency of rotation is lower. That is the reason why heavy whorls are not used for spinning fine yarn. It is not surprising, then, that half a kilogram of cotton may yield 100 km yarn or more, or half a kilogram of hand-spun Chinese ramie up to 60 km.

A few simple examples will show why all this technology of spinning played such an important role in textile history and in the history of economic and social development.

Supposing that the yarn produced was of hemp or ramie, and all the essential working steps prior to spinning had already been executed (but are not included in our calculation), in a 15 hour working day a spinner could produce about 2000 m[b] of yarn with a fineness of Nm 17 and a whorl weight of 20 g, putting 360 twists into a length of yarn of 1 m length. In the Near East flax was usually doubled after this process, but Chinese archaeological reports indicate that this was not done in China in neolithic times. If then we consider as average a warp density of 20 threads per cm and a total warp length of 12 m wound around a sort of warp-beam, we arrive at the result that one horizontal loom with a fabric width of 50 cm could have been dressed with the spun yarn produced from six days of spinning. But the yarn for the weft still had to be spun, and this needed another six days; again supposing 20 threads per cm, this comes to a total of 12,000 m. Based on these calculations, we can say that a spinner needed twelve days to provide the weaver with the yarn necessary to weave a coarse fabric of the above width and length. The weaver then needed some two days to weave the threads into a fabric, when working at the rate of 15 picks a minute.[0]

One further example is desirable to show how the labour of spinners increased when a better quality of yarn was wanted. Ramie of a fineness of Nm 34 may have been spun with a spindle of 15 g in weight, putting a twist of about 500 turns into 1 m of yarn. The yarn spun would amount to some 143 m per hour or about 4.2 g per hour. To produce a fabric 50 cm wide and 12 m long, with a density of 25 warps and 25 wefts per square centimetre, a spinner would have needed about 17 to 18 working days. The weight of one square metre of fabric would have been

[a] Linder (i), p. 59; see also Schwarz (5), p. 2165.

[" This figure includes a 20% reduction in the length because of the long working time of 15 hours a day.

[c] This figure includes a 10 % reduction in the number of picks; 26.6 hours are regarded as two working days. The figure is based on the cottage industry weavers of Switzerland in + 1760 who managed about 20 picks in one minute at a fabric with a width of about 60-90 cm, made of cotton-cretonne, 120 g/m, 24:23 threads per cm, yarn of Nm 34/34; see Linder (1), p. 145.

around 73 g, which is a good middle quality cloth. The weaver would have required about two-and-a-half working days to make the fabric.[a]

From these examples, we can see that the spinner's working time increases with the quality of yarn to a larger degree than the weaver's (assuming he produced tabby cloth only). In the examples above, the spinner's work increases by about 50%, the weaver's by about 25% as is evident from the working hours needed.

This short and tentative discussion can at least give an impression of the intensity and efficiency of the spinning work in the — 2nd millennium. Bearing in mind that apart from spinning and weaving, other essential working steps had to be performed, such as warping the warp-beam, dressing the loom and dying the material, we can imagine how long it took to produce one roll of cloth.

(3) TEXTUAL EVIDENCE FOR THE HAND-SPINDLE

Apart from material remains, there is textual evidence about the use of hand-spindles in the Near East and in China. This means that a special textile terminology was invented and used even at this early stage.

In Egypt during the period of the Ancient Kingdom, the hieroglyph for

spindle[b] *pn* 

shows a low-whorl spindle with a spiral groove round the spindle-rod. As Montell defined it in his article,[0] the term high-whorl spindle is used to denote a type where the whorl is placed above the middle of the spindle-rod, and vice versa, a low-whorl spindle is one where the whorl is placed below the middle. In the Middle Kingdom period, we recognise a

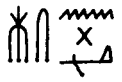
high-whorl spindle[d] *ḥśf* 

with a hook at the top of the spindle-rod.

Spinning[e] *ḥśf* 

* **A total of 33.3 working hours are regarded here as about two and a half working days.**
[b] **Erman and Grapow (1), vol. 1, p. 508. a; Forbes (13), vol. 4, p. 168.**
[c] **Montell (3), p. no, n. 1.**
[d] **Erman and Grapow (1), vol. 3, p. 335.4.**
[e] ***Ibid.*, p. 335.5.**

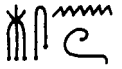
is derived from the name of the spindle. Hand-spinning as shown in the tomb of Daga[a] was pronounced

mśn[b] 

which was also the meaning of 'to repair by spinning' and which was **mostly** used with

śśn[c] 

another word for spinning. The name of the female spinner was

mśn[d] 

often used as an adjective describing goddesses. A type of spinning, probably where the thread was doubled is meant by

ḥsj[e] 

and these are just a few of the important terms in this context.'

R. J. Forbes[8] also listed some terms from Sumerian pictograms such as *gisBal,* a spindle made of wood, pottery, stone or ivory,[h] and the high-whorl *gasu* or *isgasu,* Akkadian *pilakku,* which is mentioned in the context of carded wool *napsu* taken from the sliver *kunsu.* It indicates that a wooden whorl was used.[1]

As already remarked previously,[3] the Chinese character *wa*[l] is traditionally understood—in the context of textile technology—as the whorl of the spindle, and *pars pro toto* as the hand-spindle. It has also been shown that the earthenware tile *wa* was used to roll fibres, though all the commentaries to the *Shih Ching* (Book of

» **Davies (i), pi. XXXVII.**
•> **Erman and Grapow (i), vol. 2, p. 144.12.**
[c] ***Ibid.*, vol. 4, p. 293.9.**
[d] ***Ibid.* vol. 2, p. 144.16.**
[e] ***Ibid.*, vol. 3, p. 159.2.**
» **Spiegelberg (1), pp. 568-70.**
* **Forbes (13), vol. 4, p. 168.**
» **Ungnad (1), pp. 154-5.**
[1] **Forbes (13), vol. 4, p. 170, n. 2.**
! **See above, ch. (c), (2).**

[1] 瓦

Odes) explain *wa* as spinning-'whorl'*fang-chuan*[1], also pronounced *chhien.*[8.] In the *Tti Phien* (Jade Page Dictionary) of +543 by Ku Yeh-Wang, *chuan*[2] is defined as *chuan*[3]*?* Interpretations[0] in Sung times expanded the Han definition of *tshun**, 'earthenware implement',*[1] to 'spinning-weight' *fang-chhui*[9]. Wang Chen of the Yuan period added another character to denote the spinning-whorl, namely *tko*[se] as *hsiao-tho*[6], 'small millstone', either made of wood or stone.

To judge from the dictionaries, *chuan*[7] and *chuan*[8] were commonly used during the — 1st millennium, followed later by *chhui.* Nowadays the spinning-whorl is named *fang-chhui*[9] and *fang-lun*[10], and when used as a flywheel, *fei-lun.*[11] The meaning *of fang-lun* is ambiguous because it also denotes the spindle-wheel. An even more modern term *shou-fang-ting*[12] means hand-spinning spindle.[1] The spindle-stick or spindle-shaft is called *chou*[1]***, sometimes *chui-keng*[1]* 'the sinking stick while weighted at the bottom'.

Apart from definitions as they are provided in Chinese dictionaries, many pictographs on oracle-bones from the Shang are available to us.[g] Although we are not yet in a position to ascribe definite meanings to these pictographs, their form gives clear evidence of the use of hand-spindles.[h]

The *Chia-Ku Wen-Pien* (The Compilation of Inscriptions on Oracle Bones and Shells) by Sun Hai-Po contains thirty-one pictographs resembling the character *chuan*[15.1] Two of them are depicted below:



前 六, 五, 四　　明 一五三八

They depict a hand-driven instrument (in one case driven from the left, in the other from the right), which is round. The small circle at the bottom of the pictograph could be the whorl and the big round- or oval-shaped body may depict the

[a] We do not consider it necessary to repeat the sources already listed and discussed in the article by Tsou Ching-Heng and Wang Jo-Yii. Only new material, not mentioned in these articles, will be given in footnotes below. Tsou Ching-Heng *(4)* pp. 211-22, esp. pp. 211—13. Wang Jo-Yii (4), pp. 75-7. *CWTTT,* no. 21936: see abo in the recently published *Shih Ching Chhiian I* (Complete Translation of the Book of Odes) by Yuan Yu-Ying, Thang Mo-Yao (/), pp. 276-7. Sometimes *chuan* is written without *thu* on the left side, *Khang-Hsi Tzu Tien,* p. 165.

[b] *Tit Phien,* ch. 2, p. 44b; the work was extended and edited by Sun Chhiang in +674. See also, *CWTTT,* no. 5518; Giles (1), no. 2706: a brick, a square flat tile for paving.

[0] Tsou Ching-Heng *(4),* p. 213. « *SWCT,* ch. 5 *hsia,* p. 8b.

[e] *NS* (+ 1530), ch. 25, pp. 3ab; *CWTTT,* no. 24900.

['] *Ting-tzu* is the spindle as used in the modern textile industry, see Lu Min-Chi (/), p. 138; Anon. (76b), p. 443.

[8] From the textual context in which these pictographs appear, no conclusions can be drawn about spinning. It is a mere guess by Wang Jo-Yii and Kao Han-Yu.

[11] See also Kao Han-Yii (/), p. 45. Wang Jo-Yii (4).

[1] Sun Hai-Po (/), ch. 3: 23.

[1] 紡塼 [2] 塼 [3] 甎 [4] 鑮 [5] 碢 [6] 小碢
[7] 塼 [8] 甎 [9] 紡錘 [10] 紡輪 [11] 飛輪 [12] 手紡錠
[13] 軸 [14] 墜梗 [15] 專

spindle-shaft with the yarn wound around it. The graphs indicate that three yarns are 'spun'.

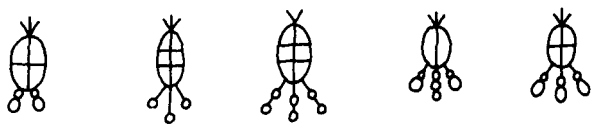
The character in question, now pronounced *fit,* was probably not distinguished from *chuan* in Shang times.[8.] From twenty-four pictographs three have been chosen for reproduction here:[b]



甲 二三四一 甲 三一〇三 鐵 二六八.四

Drawing an analogous conclusion, these show spinning with a stick, but without a whorl.

A highly interesting pictograph[0] depicts two or three silk threads being combined into one by twisting or doubling with the hand-spindle. The shapes of the silk—arranged below the spindle in several examples of the character—indicate that reeled silk was processed:[d]



粹 前 後 京津 京津
一一二五 七一二一 一一三四 一六一 一五六八

(4) CHINESE SPINDLE-WHORLS OF THE NEOLITHIC PERIOD

Before beginning to describe whorls from neolithic sites,[e] a few introductory notes seem desirable. Excavation reports in Chinese archaeological publications mention spindle-whorls very often, though good photographs and precise descriptions are rarely provided. Details concerning size and shape, material and weight are missing in many cases. Going through all the published reports available to us,[1] we may say that while most sites yielded only a few samples, sometimes only one, there were some with dozens, even hundreds of whorls. In our case it does not matter whether there was one or one hundred whorls found at a particular place, because even a small number proves the existence of a technology in a given region just as

[a] Shima Kunio (2), p. 577. [b] Sun Hai-Po (/), ch. 3: 23.
[c] *Ibid.,* ch. 13: 2. « Kuhn (8), fig. 1: 3.
[e] Cheng Te-Khun (20), p. 5 remarked: 'We still know very little about (the Early Neolithic) period; there is as yet hardly any dividing line between the Mesolithic and Early Neolithic stages in China.'
[1] We went through *Wen Wu* (Cultural Relics), *Khao Ku* (Archaeology), *Khao Ku Hsiieh Pao* (Acta Archaeologia Sinica) and their various forerunners, also through the monographs of neolithic, Shang and Chou excavations available in the Cambridge University Library, in the East Asian History of Science Library, Cambridge, and in the Ostasiatische Abteilung des Kunsthistorischen Instituts der Universität Heidelberg. A few publications were lent by the Staatsbibliothek Preussischer Kulturbesitz, Berlin.

well as a large number would do. However, the numbers may be of some importance in gaining an impression of the degree of spinning activity at any place.

The archaeological sites yielding whorls, wherever they are in China, may help to indicate the distribution of spinning technology and may even show regional peculiarities. But we must be aware that the study of whorls embodies some uncertainty as well. As was pointed out above, the results used depend on Chinese archaeological reports, and what appears in these reports follows from the decision of archaeologists about where to excavate. Such decision making is crucially influenced by coincidences, by accidental discoveries of sites when constructing roads when building new irrigation works, and so on. Finally, the archaeologists would choose what the material was to be published, basing their decision on their evaluation of the remains they had discovered. Hence it is likely that a lot of material, considered less significant and which may include whorls, is stored away in provincial museums.

As a result this part of the research should be regarded as tentative, needing perhaps revision or enlargement in the near future when more material preserved in Chinese museums becomes known to western scholars.

A technical point of some importance is how to present the material, and the following way has been adopted.

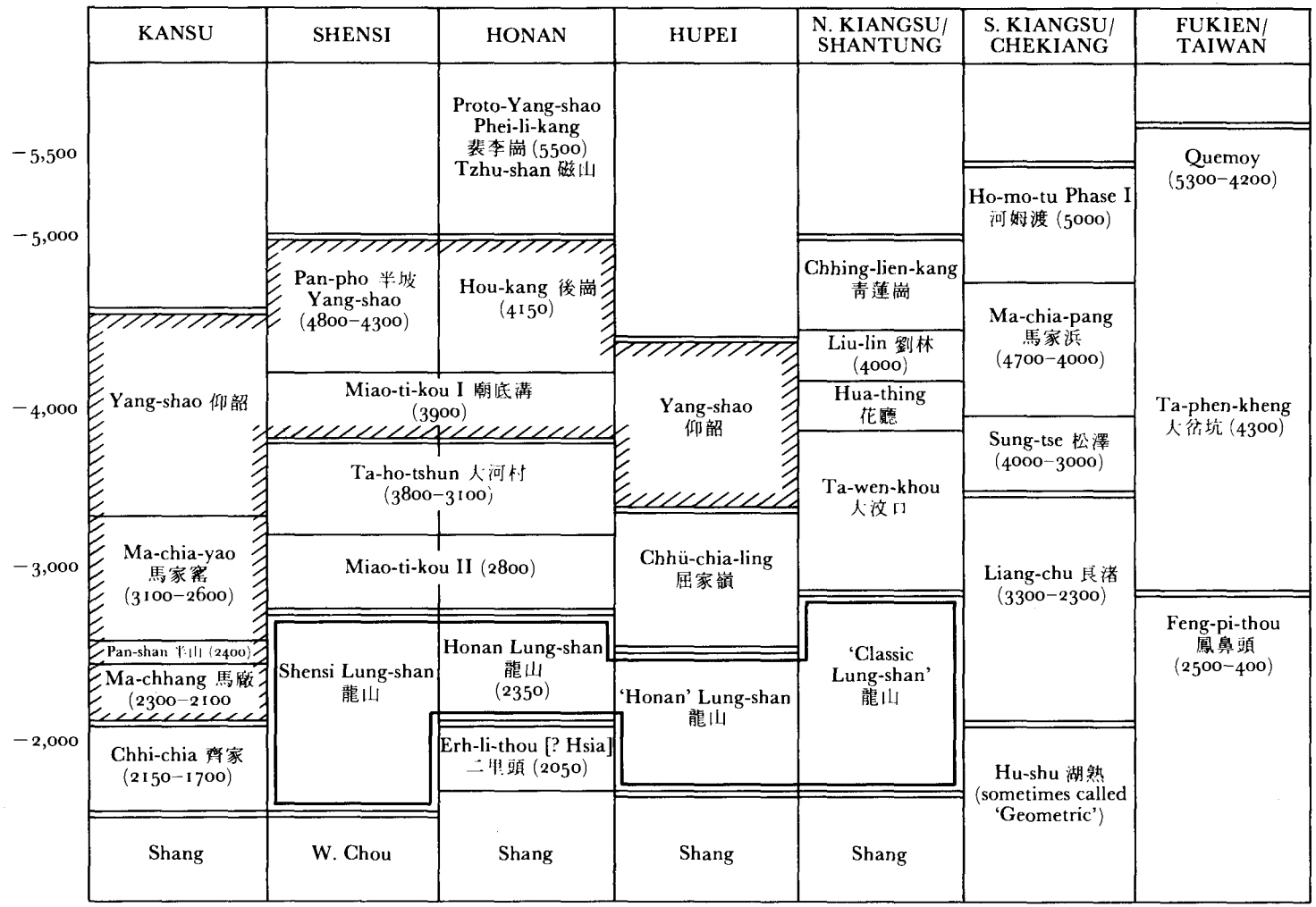
1. The spindle-whorls found at neolithic sites are discussed chronologically. This means that we start with the early finds from Ho-mu-tu-, Chhing-lien-kang-, Ma-chia-pang- and Yang-shao-sites all dating from about —5000 to —3000. Thereafter follow all the lungshanoid cultural sites such as Chhü-chia-ling, Liu-lin, Hua-thing, Miao-ti-kou II, Than-shih-shan and so on, as well as the local Lung-shan cultural sites beginning with the classical Lung-shan culture of Shantung province, the Shensi province Lung-shan (Kho-hsing-chuang II), the Chhi-chia- and Liang-chu-sites, all ranging between about —3200 and — 1800.

As the reader will discover, there are exceptions to this general rule, especially when details from the neolithic sites concerned have not been published in western literature and not defined properly in Chinese archaeological reports. In a few cases the dating of a find or the attribution of a site to a particular culture is doubtful, and a question mark has been added.[a] It constituted no problem to arrange the material in a chronological order but maintaining a geographical order at the same time turned out to be difficult. In consequence an attempt has been made to begin each part with the most important sites, and then taking into account all the minor sites in the same province and in neighbouring provinces. In this way all the provinces of China have been covered, though to anyone not well versed in the geography of China, it may sometimes be strenuous to follow the text. To help, Table 1 of cultural sequences in neolithic China has been prepared.

2. Maps I, II and III give an impression of the geographic distribution of neo-

» Just recently a publication on radiocarbon dating (Anon. *{604})* was published in Peking. Its arrival was too late for its results on the finds at various sites to be incorporated in this study.

Table 1. *Cultural Sequences in Neolithic China*



lithic sites containing spindle-whorls. Map I covers the sites dated between about —5000 to —3000; map II covers the sites dated between about —3200 to —1800, while map III includes most of the neolithic sites producing the spindle-whorls mentioned in the text. From these maps, we find out at which places in China as a whole the technology of spinning was first practised, what the technology was like, and where the centres of textile technological activities may have been.

3. Shang, Chou and Han spindle-whorls are discussed separately from the neolithic ones. For various reasons, the former are not a focus of historical interest in any technological study. First of all, in the Shang period the spindle-whorl was used in all regions which produced whorls in the neolithic period, and secondly the whorls found so far are rather primitive and display no regional characteristics.

Thirdly, during Chou times, and perhaps even earlier, a 'revolution' in spinning technology took place; this was the invention of the spindle-wheel. Thus the spindle-whorl was used only in underdeveloped areas of China or in the production of special bast fibre yarn. The far more advanced technology of the spindle-wheel was already widespread in Han China, as is testified by pictorial evidence and by Chinese terminology.

4. The typology of spindle-whorls displays their various shapes, and provides concentrated information on regional features and peculiarities of the various cultures.

(i) *Whorls Excavated at Sites Dated between* c. —5000 *to* c. —3000

It seems reasonable to start with the neolithic site of Ho-mu-tu[1], Yu-yao-hsien[2] in Chekiang province, which presents us with an excellent example of an early culture named after the place Ho-mu-tu (Fig. 32). The Ho-mu-tu people had already achieved considerable experience in rice cultivation, in general agriculture, and in technology applied to everyday life. Excavations provide a date between —4460 and —4260 for the fourth layer at the site,[8,] and between —3200 and —3000 for the second,[b] while the finds themselves were surprising in many respects, especially as far as weaving implements were concerned. All the layers yielded spindle-whorls, either of pottery, stone or wood.[0] The remarkable number of seventy pottery whorls was found in layer four,[d] fifty of them of the round flat disc-type[6] *(pien-phingjiian-hsing-shih[3])* with a diameter of about 6 cm (5.8 cm-6.5 cm) and a thickness of some 1 cm (Fig. 33). All more or less similarly shaped whorls which conform to this standard type are put into this category. Apart from this kind which is partly decorated with button-shaped impressions, ten pieces of the truncated cone type' *(tuan-mien thi-hsing-shih*)* were excavated (Fig. 33.2.3). The average whorl of this kind had a diameter at its top of 2.6 cm, and 5 cm at the

» **Chang (1), p. 551.**
« **Anon. *{504)*, pp. 39-94.**
» ***Ibid.***
* ***Ibid.*, p. 64.**
• ***Ibid.*, p. 64; p. 66, fig. 19: 1 (T16 0: 29), a(Ti 0: 13), 4(Ti6 ®: 11), $_5$(Tai 0: 17).**
» ***Ibid.*, p. 64, p. 66, fig. 19: 3(T22 0: 31).**

[1] 河姆渡 [2] 余姚縣 [3] 扁平圓形式 [4] 斷面梯形式



Fig. 32. Archaeological site at Ho-mu-tu, Yü-yao county, Chekiang province. Anon. (*504*), pl. I: 1.

bottom, with a height of 3 cm. In addition, eight pieces of the convex-shaped type[a] *(tuan-mien thu-tzu hsing-shih[1])* were found, impressed with patterns and having a diameter of 5.3 cm (Fig. 33.2.7). Their thickness increases from the edge where it is about 0.5 cm, to the centre, where it is 1.8 cm. A smaller type was discovered as well, the tag-shaped whorl[b] *{tuan-mien kung-tzu hsing-shih[2]),* measuring 2.6 cm in diameter at its top, 3.2 cm at its bottom, with a height of 2.3 cm (Fig. 33.2.6). It is a good example of a small whorl. The fourth layer also yielded a wooden whorl, measuring 5.9 cm in diameter, with a thickness of 0.9 cm, and a diameter of the hole for the spindle-shaft of 0.6 cm.[c] It is of the round flat disc-type (Fig. 33.1). The whorls all appear to have been manufactured with care and are well proportioned.

The third layer brought 21 pottery whorls to light: fifteen of the round flat disc-type, three of the truncated cone shape and three of the convex-shaped type[d] (Fig. 34)-

The second layer contained seven pottery whorls,[6] five of the round flat disc-type, the measurements of which are given as being 5.3 cm and 5 cm in diameter, 1.2 cm and 1.6 cm in thickness respectively (Fig. 35).' The first layer of Ho-mu-tu yielded eight stone whorls of the round flat disc-type[8] (Fig. 36). The diameter of one sample measures 4 cm, its thickness 0.9 cm. Furthermore, six pottery whorls of the round flat disc-type (0 6 cm, thickness 1.5 cm) (Fig. 36.1) and two pottery whorls of a ' trapezium-form' shape, about 5 cm at the bottom in

[a] *Ibid.,* p. 64, p. 66, fig. 19: 7(T32 0: 65).
0 *Ibid.,* p. 64, p. 66, fig. 19: 6(Ti 0: 25).
• *Ibid.,* p. 62, p. 61, fig. 15: I2(T28 0: 43).
« *Ibid.,* p. 76, pi. 12: 5(T33 ® 9). 6(T3i ®: 14). 7(Tai ©: 13).
[e] *Ibid.,* p. 80, fig. 31: 5(T_{35} ®: 11), 6(T_{30} ©: 9).
' The third type is not pictured.
« *Ibid.,* p. 87, p. 86, fig. 37: 6(T_{36} ©: 1).

[1] 斷面凸字形式 [2] 斷面工字形式

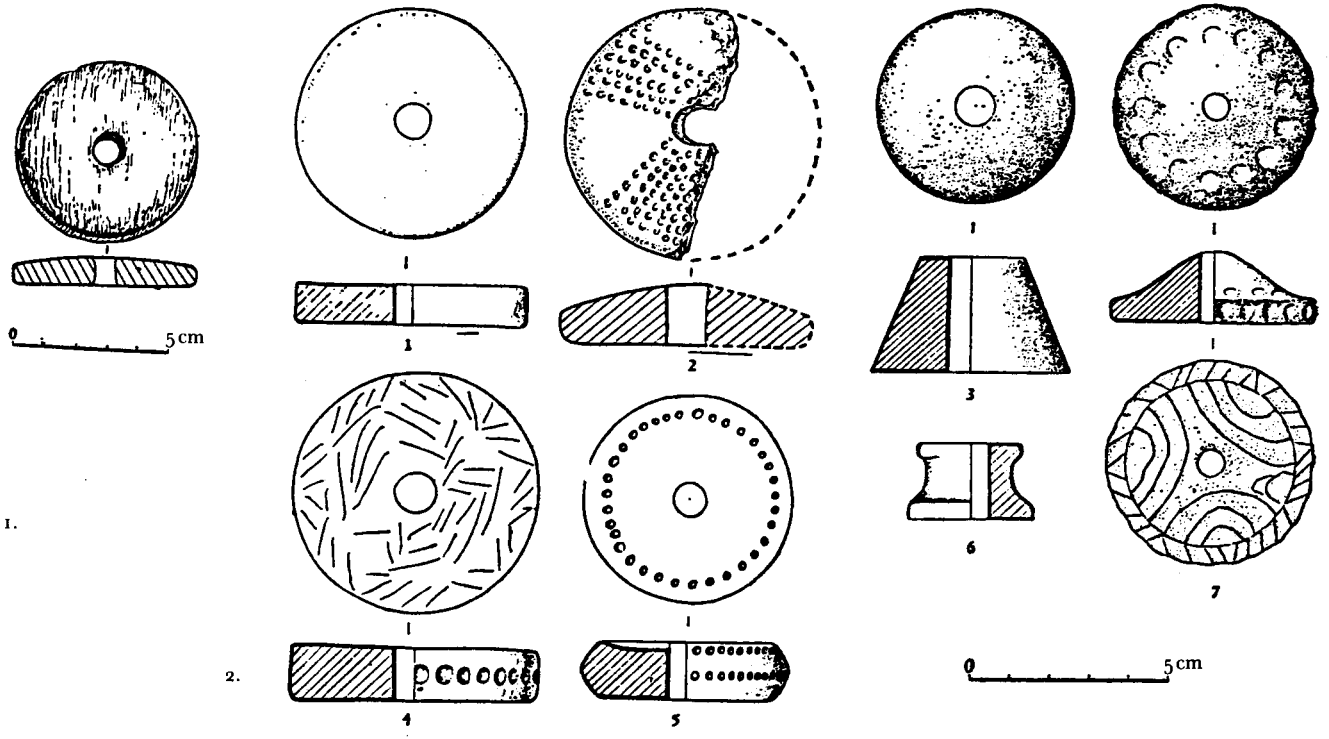


Fig. 33. Spindle-whorls from Ho-mu-tu, layer 4. 1. Wooden whorl, Anon. (*504*), p. 61, fig. 15 (T28 ④ : 43); 2. Pottery whorls, Anon. (*504*), p. 66, fig. 19, 1, 2, 4, 5.I[1] (T16 ④: 29; T1 ④ : 13; T16 ④: 11; T21④ : 17) 3. II[1] (T22 ④ : 31) 6. IV[1] (T1 ④ : 25) 7. III[1] (T32 ④ : 65).

[1] 式



Fig. 34. Spindle-whorls from Ho-mu-tu, layer 3. Pottery whorls (T33 ③ : 9; T31 ③ : 14; T21 ③ : 13). Anon. (*504*), pl. 12: 5, 6, 7.

diameter, and i cm at the top, with a thickness of about 1.5 cm were found[a] (Fig. 36.2). Regrettably no weights are given in the report, though one would guess that a light whorl might weigh about 30 g, and a heavy one about 60 g.[b] As long as Ho-mu-tu was inhabited, people practised spinning and most probably weaving too, indeed, to judge from the remains it must have been a nourishing place for many centuries at least as far as textile crafts were concerned.

The site of Ta-tun-tzu[1] in Phi-hsien[2] Kiangsu province[0] yielded spindle-whorls which, in the lower stratum, are attributed to the Chhing-lien-kang[3] culture,*[1] while those in the middle layer are attributed to the Liu-lin[4] culture, and those in the upper layer to the Hua-thing-tshun[5] culture.[6] The radiocarbon date of the Chhing-lien-kang stratum of Ta-tun-tzu lies between — 3940 and — 3730.[1] Eleven spindle-whorls, made of pottery and stone, were found. Two from the Chhing-lien-kang layer are of the round flat disc-type, one grey with a diameter of 6.9 cm and a thickness of 2.7 cm, weighing at least 100 g or more« (Fig. 37). It also displays a pattern scratched into its surface, this looking like a warp-beam when viewed from the side. Such patterning was not unusual, for there seems to have been a tradition of scratching or incising ornaments of a geometrical kind on the surface of whorls as far back as the Chhing-lien-kang cultural layer. Moreover, its weight was typical, as all the Ta-tun-tzu whorls are big and heavy, and could not therefore have been used for manufacturing fine yarn.

» *Ibid.*, p. 87, p. 88, fig. 39: I(T16 © : 6), a(T_8i © : 77).
[b] For spindle-whorl weights in China, Liang Ssu-Yung (2), p. 125.
[0] Anon. *{626)*, pp. 9-56.
[a] Chang (1), p. 137, table 6, pp. 138-40. We should note that the discussion on this culture is still going on and as far as we know at present the remains of it are confined to northernmost Kiangsu and Shantung.
[e] Cheng Te-Khun (17), p. no: finds of spindle-whorls in tombs of females.
« Chang (1), p. 486.
[8] The figure is a guess, based on Liang Ssu-Yung *(2)*, p. 125.

[1] 大墩子 [2] 邳縣 [3] 青蓮崗 [4] 劉林 [5] 花廳村

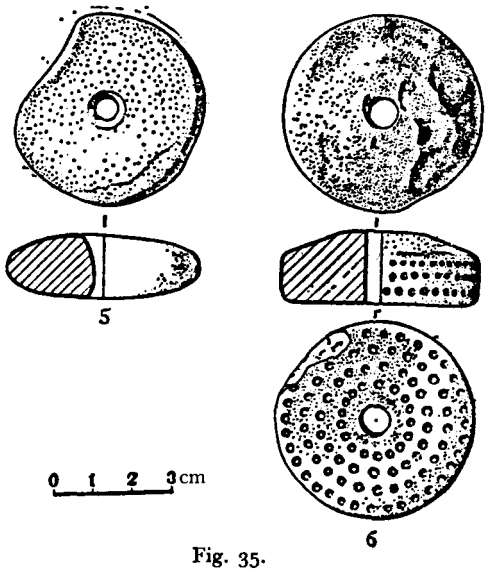


Fig. 35.

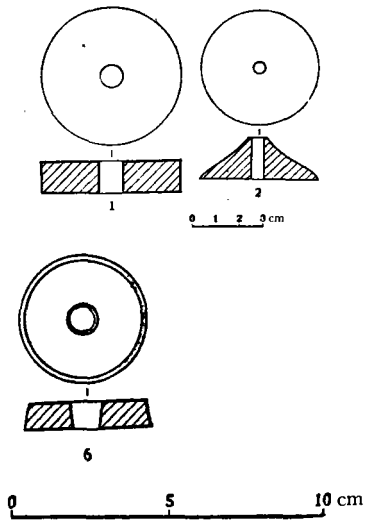


Fig. 36.

Fig. 35. Spindle-whorls from Ho-mu-tu, layer 2. Pottery whorls (T35 ② : 11; T30 ② : 9). Anon. (*504*), p. 80, fig. 31.

Fig. 36. Spindle-whorls from Ho-mu-tu, layer 1. Pottery whorls (T16 ①: 6; T31 ①: 77). Anon. (*504*), p. 88, fig. 39. Stone whorl (T36 ①: 1). Anon. (*504*), p. 86, fig. 37.

Between 1974 and 1976 a second season of excavation was conducted at the Sung-tse[1] site in Chhing-phu[2] county outside Shanghai.[3] Stratigraphical evidence indicates that the first stage of the site may be attributed to the Ma-chia-pang[3] culture, the second may be regarded as typical Sung-tse culture and the third bears evidence linking it with the Liang-chu culture. From the layer associated with the Ma-chia-pang (radiocarbon dated to the —4th millennium) ,[b] only one red pottery whorl was excavated.[0] This was a round flat disc with a diameter of 6.6 cm, and had a plain surface (Fig. 38). The middle layer, (Sung-tse culture), produced two disc-shaped pottery whorls greyish-brown in colour. Their diameters are 7.4 cm and 5.5 cm respectively* (Fig. 39).

In this context it seems appropriate to mention the site of Hsüeh-chia-kang[4] in Chhien-shan[5] county, Anhui province,[e] where from the third cultural stage of the neolithic layers, forty-six pottery whorls were excavated. This stage has close affinities with the middle layer of the Sung-tse culture site near Shanghai, and

* Huang Hsiian-Phei, Chang Ming-Hua *(i),* pp. 29-58. For more material on the Sung-tse site from an earlier excavation, see Chang (1), pp. 164-5.

[6] Huang Hsiian-Phei, Chang Ming-Hua *(1),* p. 57, p. 58: radiocarbon tests conducted on human bone remains gave dates of —5860^245 b.p. (tomb 90, second stage), —5180+ 140 b.p. (tomb 87, third stage), both calibrated.

' *Ibid.,* p. 52, fig. 17: 4(T4: 32), P- 54-

« *Ibid.,* p. 34, fig. 6: 2(Mg6: 3), 3(Ti : 3); p. 35.

[e] Anon. *(628),* pp. 283-324.

[1] 崧澤 [2] 青浦 [3] 馬家浜 [4] 薛家崗 [5] 潛山

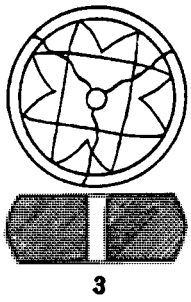


Fig. 37. Grey pottery whorl from Ta-tun-tzu, Chhing-lien-kang layer. Anon. (*626*), p. 18, fig. 8: 3 (大T3: 1).

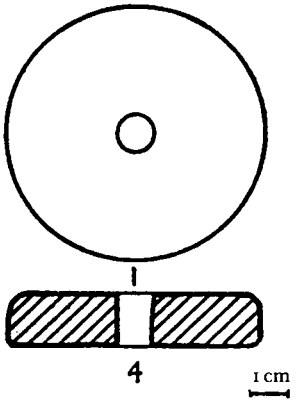


Fig. 38.

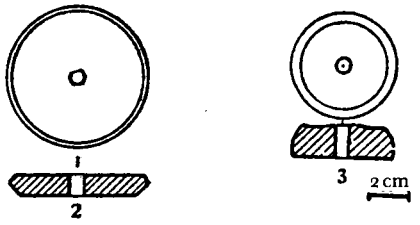


Fig. 39.

Fig. 38. Pottery whorl from Sung-tse, Ma-chia-pang phase. Huang Hsüan-Phei and Chang Ming-Hua (*1*), p. 54, p. 52, fig. 17: 4 (T4: 32).

Fig. 39. Pottery whorls from Sung-tse, Sung-tse culture. Huang Hsüan-Phei and Chang Ming-Hua (*1*), p. 34, fig. 6: 2 (M96: 3), 3 (T1: 3).

may be dated about —3000 or a little earlier.[a] The whorls which were excavated can be divided into two groups: those with rounded rims and those with straight rims. The former group of 55 pieces has rims with a diagonal needle-stitch pattern on them,[b] while the nine pieces of the latter group have no patterns on them.[0] The decorated whorls measure from 4.5 to 5.5 cm in diameter, the plain type about 5 cm (Fig. 40). The layer of the second stage and the Shang layer also contained whorls.[d]

» *Ibid.*, p. 323.
* *Ibid.*, p. 313, p. 312, fig. 27: i-3(M43: 5, 101: 3, T17 0: 10).
[c] *Ibid.*, p. 313, p. 312, fig. 27: 4(T6: 0: 67).
[a] *Ibid.*, p. 293-4; [tne] Shang whorls on pp. 319-20 will be discussed later.

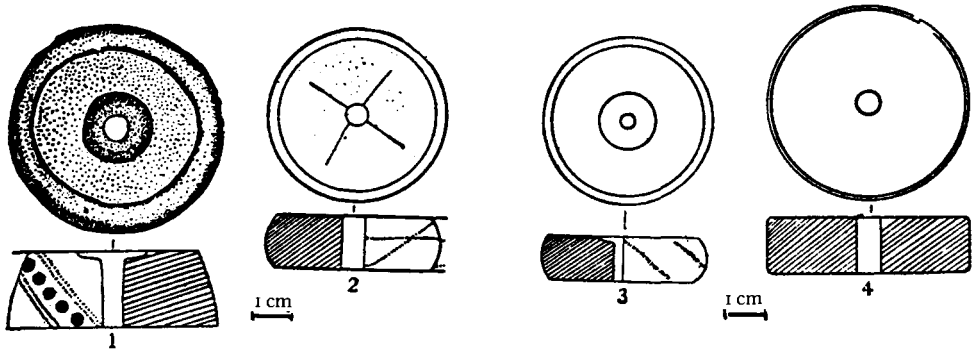


Fig. 40. Pottery whorls from Hsüeh-chia-kang, Sung-tse culture. Anon. (*628*), p. 313, p. 312, fig. 27: 1–3 (M43: 5.101: 3, T17 ④ : 10); fig. 27: 4 (T6 ④ : 67).

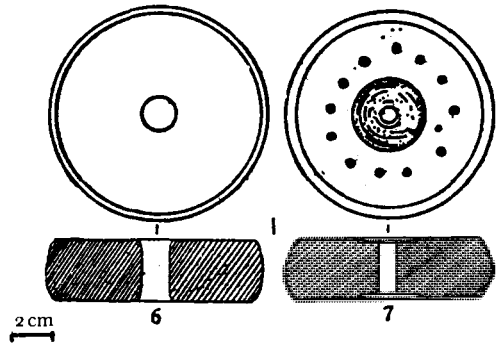


Fig. 41. Pottery whorls from Hsüeh-chia-kang. Anon. (*628*), p. 293, p. 294, fig. 12: 6 (M96: 3); 7 (M98: 3).

In the second stage at Hsüeh-chia-kang seven pottery whorls were found. They are of the round flat disc-type, with extremely large diameters of 11.2 cm[a] and 11 cm[b](Fig. 41). So far we do not know of other sites yielding such large whorls.

Having mentioned the sites in Chekiang and Kiangsu attributed to the so-called Ho-mu-tu 'culture', and those of the Chhing-lien-kang, and Ma-chia-pang cultures,[0 d] we turn now to Honan and Shensi provinces. Here there are sites of the Yang-shao[1] culture,*[5] belonging to the — 5th and — 4th millennia. The Sian site of Pan-pho-tshun[2] is dated —4225 to -4005[1] and described in a monograph.[8] Altogether fifty-two whorls were excavated here, but only nine of them were undamaged and completely preserved.[11] Two whorls made of stone were in the form of round flat discs[1] (Fig. 42) as were 43 of the pottery whorls. The latter

» *Ibid.*, p. 293 (M96: 3).
" *Md.*, p. 293 (98: 3).
0 Anon. *{726)*, p. 12, fig. 9: 2.
d Chang (1), p. 486.
e See a list of Yang-shao sites in Chang (1), p. 95.
' Chang (1), p. 485.
s Anon. *(671).*
b *Ibid.*, p. 81.
» *Ibid-, p.* 81, (XV:1).

[1] 仰韶 [2] 半坡村

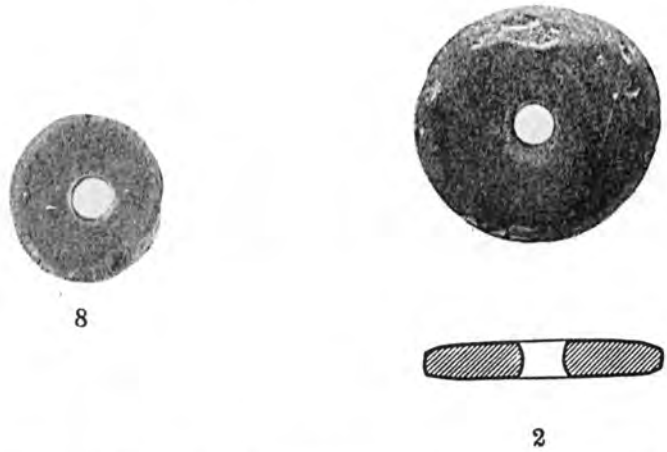


Fig. 42. Stone whorls from Pan-pho-tshun, Yang-shao culture. Anon. (*671*), pl. LXXXIX: 2 (P. 6918); 8 (P. 6519).

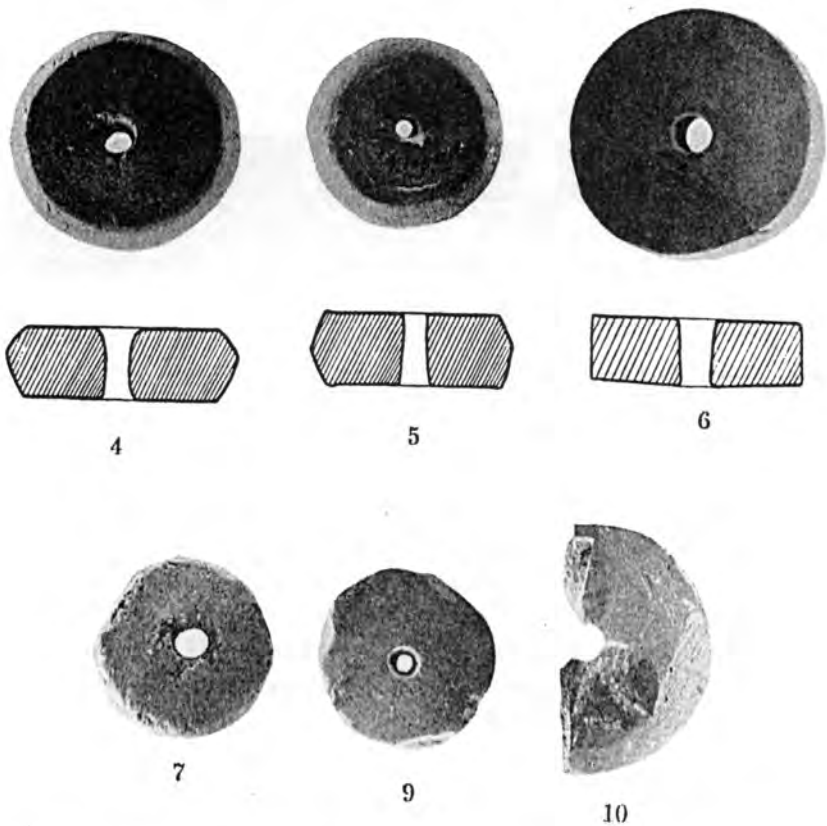


Fig. 43. Pottery whorls from Pan-pho-tshun, Yang-shao culture. Anon. (*671*), pl. LXXXIX: 4 (P. 22208); 5 (P. 22209); 6 (P. 22210); 7 (P. 22211); 9 (P. 22212); 10 (P. 22213).

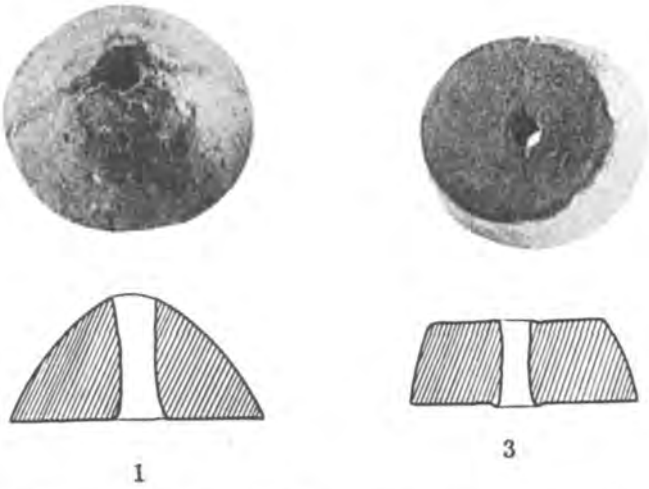


Fig. 44. Pottery whorls from Pan-pho-tshun, Yang-shao culture. Anon. (671), pl. LXXXIX: 1 (P. 22206); 3 (P. 22207).

have polished surfaces.[8-] Diameters vary between 3.5 to 6 cm, with a thickness of between 0.5 to 1.5 cm.

Most of the whorls are made of fine mud, but some are of pottery clay. There is, however, another group of pottery clay whorls which may be described as round (double) cone shape *(yiian-chui-hsing[1])* .[b] Three pieces are smaller at the top than at the bottom[0] (Fig. 43), while four pieces with a bottom diameter of 6.5 cm and height of 2.5 cm are pointed towards the tip[d] (Fig. 44).

It is noteworthy that all the whorls excavated at the Pan-pho site are neidier painted nor incised with a pattern. This seems rather surprising, because the painted pottery of the site displays imaginative power executed in skilful craftsmanship.

The Yang-shao layer of Miao-ti-kou[2], near Shan-hsien[3] in Honan, dating from between —3380 to —3180,[e] provided fifteen stone whorls of the round flat disc-type' and also eighty-five pieces of pottery[8] (Fig. 45). Sixty-eight whorls are very thin and small compared with the others mentioned above; they measure some 4.4 cm in diameter and less than 0.5 cm in thickness. They are made of fragments of pottery,[h] which explains the irregular stroke-like pattern[1] (Fig. 46.2), from which it will be seen that the hole to take the spindle-shaft in the example pictured is not centred accurately (Fig. 46.3). There are fifteen red pottery whorls made

» *Ibid.*
[c] *Ibid.*, p. 81, (XV:2a); pi. LXXXIX:3.
[d] *Ibid.*, p. 81, (XV:2b); pi. LXXXIX:!.
' Anon. (71*), p. 58, p. 56, fig. 38 (H327: 11).
[8] *Ibid.*, p. 51, fig. 33: 2, pi. 46: 11 (H7: 83, T74: 04).
[h] From information supplied by Hsia Nai.

» *Ibid.*, p. 81, (XV:2).
[e] Chang (i), p. 485.
' *Ibid.*, p. 51, fig. 33: 2.

[1] 圓錐形 [2] 廟底溝 [3] 陝縣



Fig. 45. Stone whorl from Miao-ti-kou, Yang-shao culture. Anon. (*712*), p. 56, fig. 38 (H327.II); pl. 51 : 6, 7.

from fine mud; they are rather big in size (0 about 6 cm, thickness 1.4 cm), but another is very small, 0 2.8 cm? Of the third type which is very similar to a truncated one, only two specimens have been found.[b] The diameter at the bottom of the whorls measures about 4.8 cm and 5.6 cm respectively, the height some 3.4 cm and 3.8 cm (Fig. 46.4; Fig. 46.5). One sample is covered with impressed ornamentation.

The Yang-shao layer of San-li-chhiao[1] yielded nine pottery whorls similar to the specimens excavated at Miao-ti-kou. Six whorls made of stone were found as well.[0] The Lung-shan[2] layer of Miao-ti-kou yielded six pottery whorls,[d] the Lung-shan layer of San-li-chhiao produced nine, made of pottery clay, all with a diameter of only 3 cm.[e] The site of Chhi-li-phu[3] in Shan[4] county contained whorls in the Yang-shao and Lung-shan layer.[1]

The overall impression we get from the shapes and the way the whorls are made must lead us to the conclusion that the whorls were produced rather carelessly. Most of them are not centred. The decoration lacks imagination. There were no innovations.

At the Ta-ho-tshun[5] site, north of Cheng-chou, three pottery whorls were excavated which according to their archaeological strata, belong to the Chhin-wang-chai[6] phase of the northern Honan Yang-shao culture.[6] The site is dated between —3175 and — 2975.[11] The diameter of the whorls varies between 3.1 cm to 6.5 cm, the large type having a flat round disc with a thickness of 0.8 cm, while the other round type—hexagonal, seen from the side - has a thickness of 1.6 cm.[1] The drawings of the whorls clearly show that they are not well proportioned (Fig- 47)-

* *Ibid.,* p. 51, fig. 33: 3(T243: 03); pi. 46: 12^245: 04), 13^243: 03).
» *Ibid.,* p. 51, fig. 33: 4(H2ig: 12), 5^319: 19); pi. 46: 14, 15.
[0] *Ibid.,* p. 92.
[a] *Ibid.,* p. 76, p. 77, fig- a($H_5 6_4$: 13); pl- 68= 8, 9.
[e] *Ibid.,* p. 101. ' Anon. *(664),* pp. 177-9.
« Anon. *{614),* p. 336, fig. 7: :, 6.
[b] *Ibid.,* p. 336; Chang (1), table 5; p. 93; p. 127; p. 485.
[1] Anon. (6/4), p. 336.

[1] 三里橋 [2] 龍山 [3] 七里鋪 [4] 陝
[5] 大河村 [6] 秦王寨

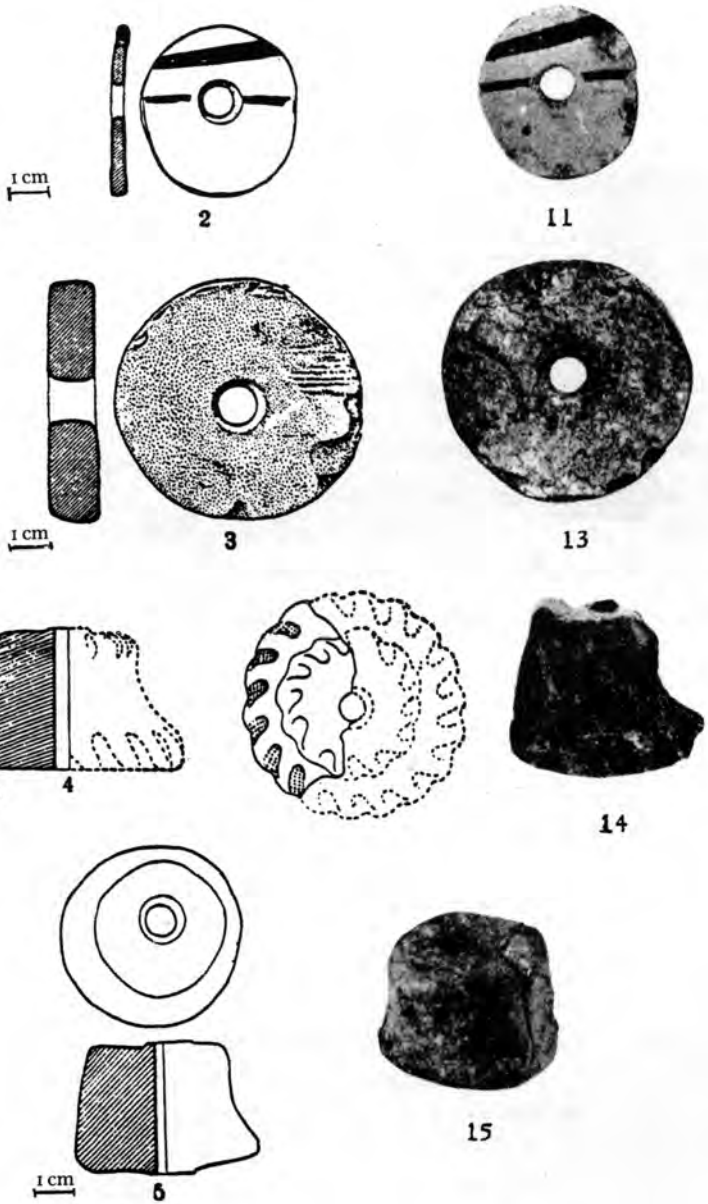


Fig. 46. Pottery whorls from Miao-ti-kou, Yang-shao culture. Anon. (*712*), p. 51, fig. 33: 2 (T74: 04), pl. 46: 11; p. 51, fig. 3; (T243: 03), pl. 46, 13; p. 51, fig. 4; (H219: 12), pl. 46: 14; p. 51, fig. 5; (H319: 19), pl. 46: 15.

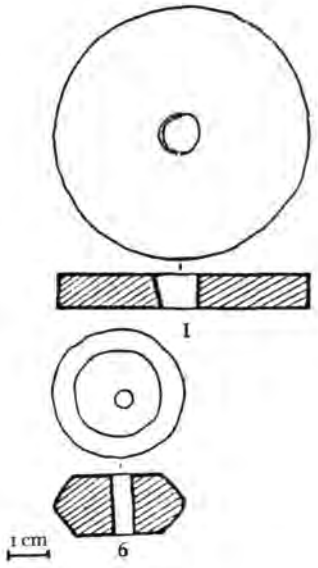


Fig. 47.



Fig. 48.

Fig. 47. Pottery whorls from Ta-ho-tshun, Yang-shao culture. Anon. (*614*), p. 335, p. 336, fig. 7: 1 (F1: 5); 6 (F1: 6).

Fig. 48. Stone whorl from Hsi-ho-an-tshun, Yang-shao culture. Anon. (*662*), p. 498, fig. 1: 5 (H18: 1).

In the western suburb of Cheng-chou, five pottery and nine stone whorls were excavated, and can be attributed to the Yang-shao culture.[a] At the site of San-li-tien[1], in Hsin-yang[2], Honan province, one pottery whorl of the late Yang-shao period was found.[b] The site of Hsi-ho-an-tshun[3] in Mien-chhih[4] county yielded one whorl, made of stone, with a diameter of 6 cm and a thickness of 0.8 cm[c] (Fig. 48).

In 1964 and 1965 the site of Pei-pao-chai[5] was discovered near Wang-chhü[6] in Chhang-an county, Shensi province.[4] It is attributed to the Yang-shao culture, and among other items it yielded three spindle-whorls. One was a pottery whorl with a diameter of 5 cm and a thickness of 1.5 cm/ belonging to the round disc-type (Fig. 49). Another measuring 5.5 cm in diameter and 2.2 cm in height was of the truncated cone type with a stepped structure; seen from above it isfourteen-lobed, while the whole structure has a pattern of cord-impressions (Fig. 49.16). A lobed piece from Miao-ti-kou is also known.[f] The third whorl has a diameter of 4 cm and a height of 2 cm. It is made of pottery and has a brown colour.[8]

[a] Anon. *(611),* p. 4.
[0] Anon. *{662),* p. 498. 1
[d] Feng Chhi-Yung, Ghou Hung-Hsing (/), pp. 84-7.
[e] *Ibid.,* p. 84, p. 85, fig. 2: 14; fig. 2: 16.
« Feng Chhi-Yung, Chou Hung-Hsing (;), p. 84.
b Anon. *(657),* p. 10; pi. 3: 13.
» See above, Fig. 46.

[1] 三里店 [2] 信陽 [3] 西河庵村 [4] 澠池 [5] 北堡寨
[6] 王曲

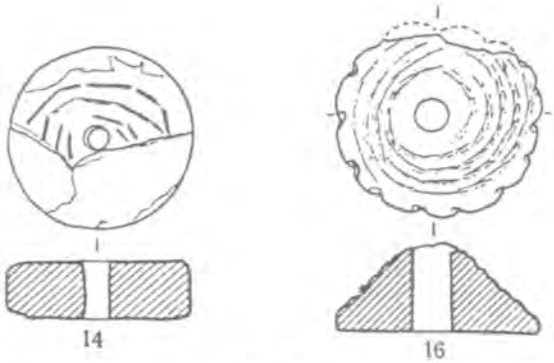


Fig. 49.



Fig. 50.

Fig. 49. Pottery whorls from Pei-pao-chai, Yang-shao culture. Feng Chhi-Yung & Chou Hung-Hsing (*1*), p. 84, p. 85, fig. 2: 14, 16.

Fig. 50. Pottery whorl from Phei-li-kang, Honan. Anon. (*688*), p. 338, fig. 2: 7 (T310 2: 4); p. 339.

Other samples of stone and pottery whorls were excavated from the site of Hsi-wang-tshun ' at Jui-chheng[2] in Shansi province.*

The site of Phei-li-kang[3] in Hsin-cheng[4] county, Honan province, a site whose cultural affiliation is still uncertain, has so far been excavated for three seasons between 1977 and 1979, and has yielded many exciting remains. But regrettably spindle-whorls, which are so often found in Yang-shao sites, could not be found in the first and second excavations.[15] Only the third produced one type of the round flat disc-type, decorated with small impressed marks (Fig. 50).°

Judging from the Chinese radiocarbon dating the layer should lie between about -5495 and -5195,[0] but it would be reasonable to wait for future evidence from more sites in the region to confirm the dating of this cultural phase.

Among the eight pottery whorls excavated at the site of Teng-chia-chuang[5] near Lin-thung[6] in Shensi province, a site attributed to the Yang-shao culture, Miao-ti-kou phase, are several of the round flat disc-type, measuring between 6 cm and 7 cm in diameter (Fig. 51.8). A quite exceptional tooth-wheel shaped whorl of the truncated cone type is mentioned as well (Fig. 51.7).[6]

In autumn 1978 the shell-mound sites on the Kuang-lu[7] and Ta-chhang-shan[8] Islands in Chhang-hai" county were excavated.* The lower, middle and upper layers of Hsiao-chu-shan[10] on Kuang-lu Island yielded spindle-whorls. The lower layer produced blackish-brown pottery impressed with cords, threads and mat patterns; it may be dated about -4000.[8] The layer also contained two polished

» Anon. *(728),* pp. 1-62; esp. p. 47, fig. 41: 5-9; pi. 14: 17 (Hi : 2: 6).
» Anon. (656), pp. 73-9; esp. p. 78. Anon. *{724),* pp. 197-205.
c Anon. *(688),* pp. 337-40; esp. p. 339; p. 338, fig. 2: 7.
[A] *Ibid.,* p. 340. [e] Chao Khang-Min (1), p. 3; p. 4, fig. 6: 7, 8.
' Anon. (601), pp. 63-110.
[g] *Ibid.,* see radiocarbon dates, p. 107.

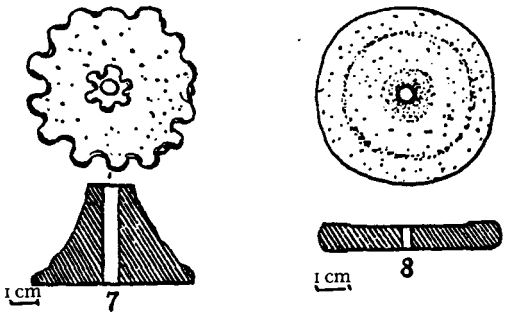


Fig. 51. Pottery whorls from Teng-chia-chuang, Yang-shao culture. Chao Khang-Min (*1*), p. 3; p. 4, fig. 7, 8.

blackish-brown disc-shaped pottery whorls.[a] The middle layer brought a total of six spindle-whorls to light. In the archaeological report they are divided into two groups: the pottery disc spindle-whorl of gritty structure and blackish-brown colour with a diameter of 5.6 cm to 6 cm,[b] and three samples, partly damaged, of the same material with a diameter of 6 cm to 7.3 cm.[0] The whorls pictured in the excavation report are decorated with incised or impressed geometric or linear abstract patterns (Fig. 52). The remains in this middle layer resemble those of the lower layer of Tzu-ching-shan site in Shantung, and probably date from about — 3000. The upper layer shows close analogies with the Shantung Lung-shan culture. It produced one spindle-whorl,[d] and should be dated about — 200o.[e]

One pottery whorl with a diameter of 4 cm with an incised pattern on its polished surface was excavated from the lower layer of the site of Shang-ma-shih[1] on Ta-chhang-shan Island.[1] The middle layer also yielded one whorl.[8]

The Yang-shao layer at the site of Pao-chi[2] in Shensi province produced one whorl.[h] A pottery whorl with a diameter of 3.5 cm from the same culture was found near Sian.[1]

The lower layer of the Tzu-ching-shan 3 site in Pheng-lai[4] on the northern coast of Shantung province may well have belonged to the Chhing-lien-kang culture.[1] The layer yielded only two comparatively small whorls, each of a convex shape, measuring 3.7 cm in diameter and 1.8 cm in thickness. The upper 'Lung-shan' layer of the site produced two damaged pottery whorls.

At this stage some comments must be made. So far we have talked about the earliest whorls found in China; these have come from sites attributed to the provisionally named Ho-mu-tu culture in northern Chekiang, the Yang-shao

» *Ibid.*, p. 70, T_4(|): a6.
» *Ibid.*, p. 77. Ti@: 13.
[c] *Ibid.*, p. 77, T5©: 4; Ta(|): 4.
[A] *Ibid.*, dating of the layers is based on the Chinese radiocarbon dates provided on p. 107.
[e] *Ibid.*, p. 82, T2®: 14.
' *Ibid.*, p. 96, IIITI0: 10.
e *Ibid.*, p. 98, IT_5(§): 31.
» Anon. *{723)*, p. 5, fig. 1: 6.
1 Anon. (670), p. 33, fig. 2: 15.
[J] Anon. *(732)*, pp. 11-15.

[1] 上馬仆 [2] 寶鷄 [3] 紫荆山 [4] 蓬萊

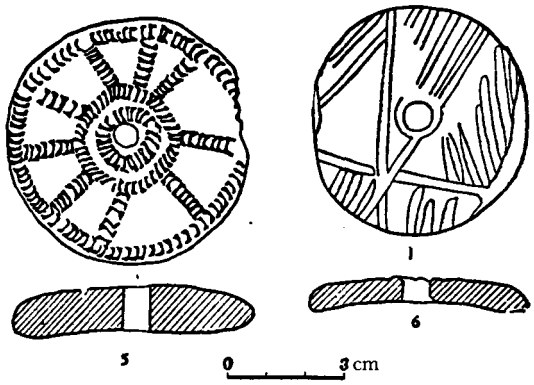


Fig. 52. Pottery whorls from Hsiao-chu-shan, middle layer. Anon. (*601*), p. 77, fig. 13: 6 (T1 4: 13); fig. 13: 5 (IF1: 39).

culture in Honan and Shensi, and the Chhing-lien-kang culture of northernmost Kiangsu and Shangtung. All have various dates, but start as early as the —5th millennium. When approaching the —3rd millennium, the high number of archaeological sites yielding whorls makes it almost impossible to treat them equally thoroughly. This is due not only to the numerical problem of the number of sites—if these were discussed, as has been done with the fifth and fourth millennium sites, we should need hundreds of pages—but far more to the problem of cultural definition and dating. The still prevalent uncertainty, mainly due to die lack of radiocarbon dates, is best mirrored in the works of Chinese archaeologists, who only dare put very important sites into the archaeological context of China as a whole. For these reasons it remains difficult to categorise minor objects such as whorls.

We cannot deal here with attempts undertaken to solve the 'Lung-shan' problem, nor discuss the linked development of neolithic archaeology in China;* that would go far beyond the scope of this study. But a few sentences should be added to make the difficulties clear and to make evident the reasons for the chronological arrangement on the maps of the sites which have yielded whorls. K. C. Chang has pointed out that a new pattern of neolithic interrelationships in China is emerging now,[b] based on radiocarbon dating. At present we can discern three neolithic cultures before about —3200, or perhaps four if Ho-mu-tu is added as a separate culture. (See Table 1 : Cultural Sequences in Neolithic China.) Their descendant cultures also began about — 3200, first the lungshanoid and their phases, and from about - 2500 various local Lung-shan cultures can be detected.[0]

» Chang (1), pp. 144-55- " *Ibid.,* p. 155. ° *Ibid.,* pp. 155-84.

(ii) *Whorls Excavated at Sites Dated between* c. *—3200 and c. —1800*

It is convenient to group together as one category, the spindle-whorls which were excavated from the following lungshanoid sites:

Chhü-chia ling[1]
Hua-thing[2]
Liu-lin[3]
Miao-ti-kou[4] II
Than-shih-shan[5]

and as another category those from the local Lung-shan[6] cultural sites:

classical Lung-shan culture of Shantung
Shensi Lung-shan, Kho-hsing-chuang[7] II
Ghhi-chia[8a]
Liang-chu[9]

These cover the period from about -3200 to — i8oo.[b] Apart from these cultures and cultural phases, a number of neolithic sites are contemporary with the historical Bronze Age Shang period (about — 16th to — nth centuries). Because many sites of the Chhi-chia[10] culture in Kansu province and the Than-shih-shan culture of Fukien province date back into pre-Shang times, they have been included under the above headings.

To complete the map of sites at which spindle-whorls were found, many neolithic sites have been added even though their culture has not yet been defined by Chinese archaeologists. One cannot therefore assign them to a particular culture, let alone a specific phase of a culture, though it seems obvious that this could be done by archaeological specialists who have the remains to hand.

For our purpose the division of the sites which yielded spindle-whorls into two periods (Map I —5000 to —3000; Map II, about —3200 to — 1800) is sufficiently precise. In addition to the two main maps, a third shows all the neolithic sites with whorls, including 'unidentified' sites. Together the maps indicate where there is evidence of a technology of applied spinning, and hence reason to assume that weaving was practised as well. Sites have been included and their cultural affiliations given according to the general ideas of cultural development now recognised by archaeologists. And though the map of distribution has to be regarded as incomplete for the reasons already mentioned,[0] it nevertheless helps to give a

[8] The Chhi-chia culture of Kansu province should not be regarded as a local Lung-shan culture in the traditional sense. The cultural affiliations are still disputed. We may say that the Chhi-chia tradition was introduced from the Yang-shao culture.

[b] We follow the cultural division devised by Chang (1), pp. 155-84; p. 173, table 8.

[c] See above, pp. 91-93.

[1] 屈家嶺 [2] 花廳 [3] 劉林 [4] 廟底溝 [5] 曇石山
[6] 龍山 [7] 客省莊 [8] 齊家 [9] 良渚 [10] 齊家

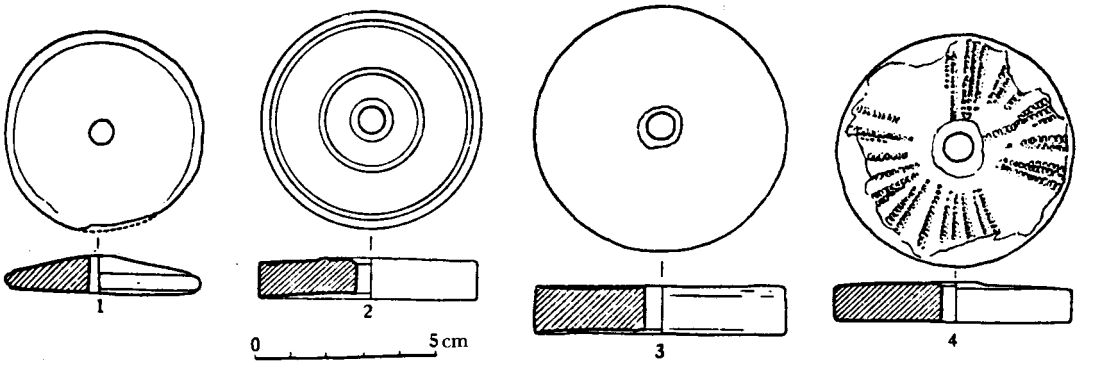


Fig. 53. Pottery whorls from Wang-yu-fang, Honan Lung-shan. Anon. (*687*), p. 40, fig. 6: 1–4 (T2 ⑤ : 1, H27: 2, H28: 2, F11: 11).

reasonable impression of the main cultural areas in those regions where textiles were being produced at a comparatively early time.

It would now seem appropriate to follow a geographical order, dealing first with sites at Honan and Shensi, and then continuing with those in the Kiangsu and Shangtung provinces. This geographical treatment will only be interrupted where a site belongs to a cultural phase or to a culture which was dominant at a given time in more than one province.

The spindle-whorls in the Lung-shan layers at Miao-ti-kou and San-li-chhiao have been discussed already,[a] so we can turn at once to the site at Tsao-lü-thai[1] in Yung-chheng[2] eastern Honan[b] which yielded fourteen spindle-whorls, varying in diameter between 4 cm and 7 cm and in thickness between 0.7 cm and 1.5 cm.[c] The lungshanoid sites in the valley of the Chien[3] River produced two whorls, one with a diameter of 6.6 cm and 1.7 cm thick.[d] Five types of spindle-whorls are mentioned in the archaeological report listing the finds made in the lower layer of the site at Wang-yu-fang[4] in Yung-chheng. They are dated as being from the late phase of the Honan Lung-shan culture (Fig. 53),[6] but regrettably they are not described. The site of Thang-chhiian-kou[5] in Yen-shih[6] contained three whorls of disc-type.[1]

The lungshanoid Erh-li-thou[7] cultural site of Kan-chün[8], I-chheng[9] county in south Shansi yielded four pottery whorls of a grey colour.[8] They are all of the

[a] See above, pp. 101-103.
[b] Li Ching-Tan (/) pp. 83-120; see also Chang (i), p. 147 and Cheng (17), pp. 97-101.
[c] Li Ching-Tan (1), p. 102, fig. 7: 1 + 2.
[d] Kuo Pao-Chün (4), pp. 11-28. See pp. 16-17; P'- 3 8.
[e] Anon. *{687)*, PP- 35-4°> ^4- See p. 40, fig. 6: 1-4 (T2 @: 1, H27: 2, H28: 2, Fi 1 : n).
[f] Anon. *{667)*, PP- 562-5, 600; see p. 565; fig. 5: 1,2, 4. Hsia Nai has said that a fourth whorl should really be regarded as a bead-type object and not a whorl as given in this reference. (Private communication, 16 June 1984.)
[g] Anon. *{62g)*, pp. 203-10.

[1] 造律臺 [2] 永城 [3] 澗 [4] 王油坊 [5] 湯泉溝
[6] 偃師 [7] 二里頭 [8] 感軍 [9] 翼城

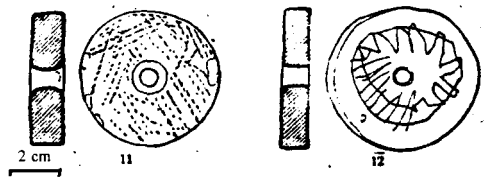


Fig. 54. Fig. 55.

Fig. 54. Pottery whorls from Kan-chün, Erh-li-thou culture. Anon. (*629*), p. 207, fig. 4: 11, 12 (H1: 12, H1: 3).

Fig. 55. Pottery whorl from Pei-liu, Miao-ti-kou II culture. Anon. (*755*), p. 5, fig. 5: 2 (M38: 2).

flat round disc-type. One sample bears cord-impressions (Fig. 54.11),[a] another an incised pattern (Fig. 54>i2).[b] The diameter of the first sample measures 6 cm, its thickness 1.5 cm, those of the second sample 6.5 cm and 1.2 cm. A very small spindle-whorl, measuring 2.6 cm in diameter and 1 cm in thickness is reported in the Chinese account, but not pictured.[0] It is the smallest whorl so far, and indicates that not only coarse yarn but also fine quality yarn was spun.

The later upper layer of the Pei-liu[1] site, south of Wei-nan[2] in Shensi province, which may be attributed to the Miao-ti-kou II culture,[4] produced four pottery spindle-whorls.[6] Only one whorl is pictured, and this measures 3.4 cm in diameter with a height of 1.4 cm; it belongs to the truncated cone type with a stepped structure* (Fig. 55).

There are many sites, scattered over several provinces, yielding remains which can be identified as Chhü-chia-ling[3] cultural artifacts.[8] Many of them contained spindle-whorls. The lungshanoid Chhü-chia-ling culture was named after the site of Chhü-chia-ling, discovered in 1954 in the hilly country of Ching-shan[4] county in Hupei province,[11] and its cultural deposits can be divided into three parts: those representing the early period, those from the first stage of the late period, and finally those from the second stage of the late period.

The early period of the Chhü-chia-ling may have been related to the Yang-shao culture, and dates from the first half of the — 3rd millennium. Its thirty-seven pottery spindle-whorls, grey, black, yellow andrred in colour, can conveniently be divided according to size. The big ones have a diameter of more than 4 cm, those of middle size range between 3 cm and 4 cm in diameter, and the small ones are below 3 cm.[1] There are two of large size, both of the round flat disc-type. Chinese archaeologists have recognised three kinds. First are whorls with a straight rim *(chih-pien*[5]*)*, decorated with a groove in the middle of the rim and at least one line

[a] *Ibid.*, p. 207, fig. 4: 11. [b] *Ibid.*, p. 207, fig. 4: 12.
[c] *Ibid.*, p. 207. [A] Anon. *(755)*, pp. 1-9.
[e] *Ibid.*, p. 5; p. 9(Hi two pieces; H5 one piece; Hio one piece).
[f] *Ibid.*, p. 5, fig. 5: 2(M38: 2); (the Chinese legend to the figure is mixed up with another figure; we have corrected it).
* Chang (1), pp. 165-7; Cheng (17), pp. 117-18; Cheng (16), pp. 33-5.
[n] Anon. *{630)*, p. 1. 1 *Ibid.*, p. 15.

[1] 北劉 [2] 渭南 [3] 屈家嶺 [4] 京山 [5] 直邊

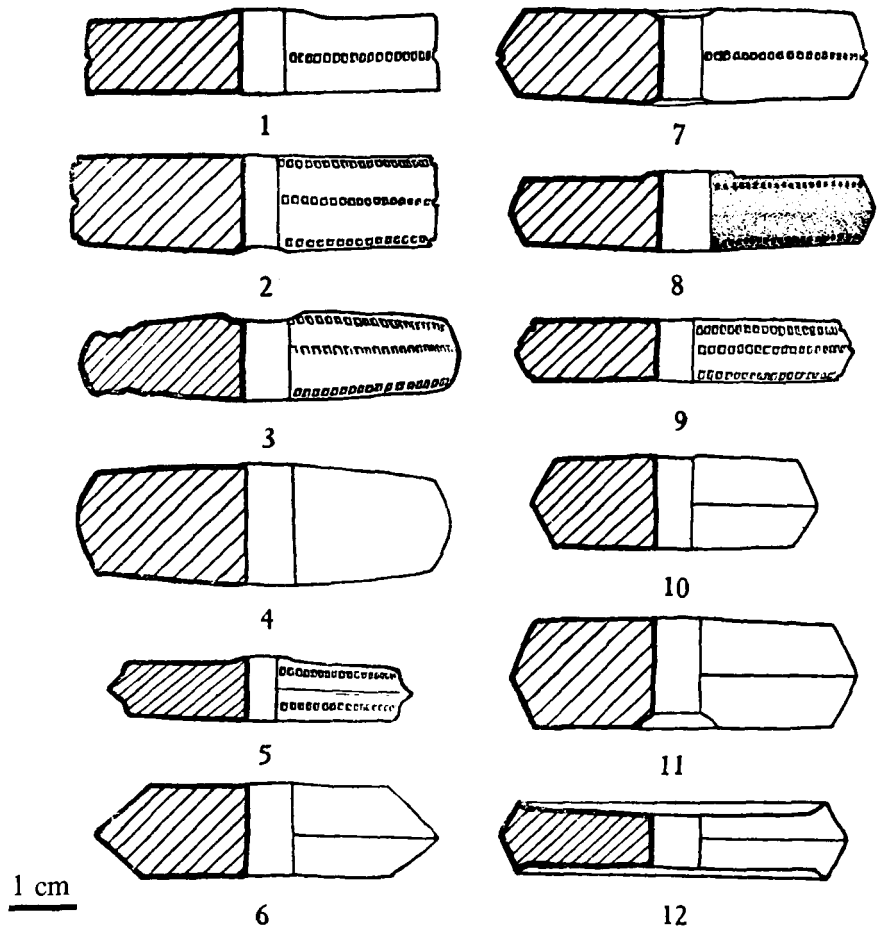


Fig. 56. Pottery whorls from Chhü-chia-ling, Chhü-chia-ling culture, early period. Anon. (*630*), p. 16, fig. 11: 1 (T84: 6(3); 2 (T84: (2); 3 (T104: 8(3); 4 (T90: 7(1); 5 (T98: 8(4); 6 (T84: 4(7); 7 (T97: 8(9); 8 (T104: 8, 8C(2); 9 (T111: 9(2); 10 (T84: 5(2); 11 (T105: 7(4); 12 (T130: 6(13). The whorls, figs. 2, 3, 6 and 8 are also photographically reproduced in Anon. (*630*), pl. 9: 10, 11, 12, 13.

of dots round the rim itself (Fig. 56.1, 2).[a] Apart from the Chhii-chia-ling cultural sites, such lines of dots have been discovered in layer four at Ho-mu-tu[b] in Chekiang province, and on a few whorls from the Sung-tse cultural site of Hsiieh-chia-kang in Anhui province.[0] But there the dot-pattern is impressed a little differently, and is not parallel to the rim. Second come five big whorls with bow-shaped rims *(hu-pien[1])*, some of them decorated also with the 'line of dots' pattern (Fig. 56.3) ; they too are of the round flat type.[d] Thirdly, thirty whorls of various sizes and

» *Ibid.*, p. 16, fig. n: i(T84: 6(3), a(T84: 6(2)).
[b] See above, Fig. 33. [c] See above, Figs. 40, 41.
<J Anon. *(630)*, p. 15, p. 16, fig. 11: 3(Ti04: 8(3)).

[1] 弧邊

shapes are grouped together as 'whorls with angular-shaped rims' *(chiao-hsing-pien[1])*. Technically speaking, most of them are of the double trapezium type, and bear some kind of rim decoration, such as a 'line pattern' *(hsien-wen[2])* or a 'line of dots pattern' *(tien-hsien-wen[3])*.[a]

The only shape which occurs in addition to the types we already know is the unpatterned whorl, illustrated in Fig. 56.12. Here, if the cross-section were cut in halves lengthwise, it would resemble an American Indian canoe. Apart from the shape of this whorl and the rim decoration just mentioned, the whorls of the early period are conventional and do not display any distinct features from which it might be possible either to locate or date them.

The late layer of the Chhü-chia-ling site is earlier than the Shang-Yin period, probably from the second half of the — 3rd millennium.[b] The unspecified number of pottery whorls from the first stage of this late period can be divided into those painted in one colour and those in many colours *(tshai-hui[4])* ; such painted whorls were exclusively found in the late period.

The monochrome whorls, either grey, black, red or yellow are large and similar to those excavated from the early period. There are twice as many of them as there are painted whorls, but all are of the same type as mentioned above (Fig. 57).

When we turn to the multi-coloured whorls, their bodies appear greyish-white, orange-yellow or greyish-yellow, and again they are already known types, though there is one type shaped like a boat—and also like a boat upside down—while others are elliptical (Fig. 58 ; Fig. 60.4, 5). Most of the painted whorls pictured are between 3.5 cm and 4.5 cm in diameter, and between 0.6 cm and 1.2 cm thick. Yet it is neither their shape nor their size which attracts us, but their painted ornamentation—the prominent characteristic of late period Chhü-chia-ling whorls. Three colours were available to or preferred by the makers; they were yellowish-orange, orange-red and brown-black.[c] Most of the decorations in these colours display geometrically arranged straight strokes or bow-shaped lines. Three whorls pictured are painted with abstract patterns which leave plenty of room for interpretation (Fig. 59, 7, 8; Fig. 60,1, 2 + 4).

The repertoire of ornaments was enlarged during the second stage of the late period, when spiral- and dot-ornaments of various types were added (Fig. 61 ; Fig. 62 ; Fig. 63), while a kind of cross-shaped pattern in the form of the Chinese character *shih*[5] also increased the already existing ornamentation. All of them have the common factor that the hole which takes the spindle-rod, was always taken as the centre of the ornament. But in addition there are features other than the ornamentation to distinguish the whorls from the first and second stage, and this is the applied colouring. Although the body of the whorls was made of fine mud of

» *Ibid.*, p. 16, fig. 11:5^98-.8(4)), 6(T8$_4$: 4(7)), 7^97:8(9)), 8(T.o$_4$:8, 8C(a)), $_9$(Tm: 9(2)), io(T8$_4$: 5(2)), u(Tio$_5$: 7(4)), $_{12}$(Ti$_3$o: 6(13)).

i> Chang (1), pp. 167, 173.

[0] Anon. *{630)*, p. 31.

[1] 角形邊 [2] 線紋 [3] 點線紋 [4] 彩繪 [5] 十

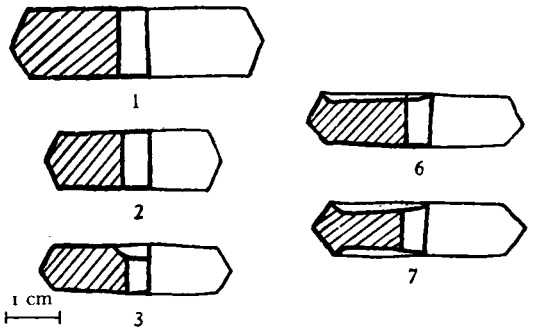


Fig. 57.

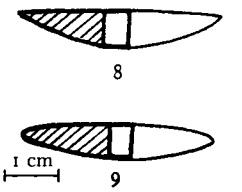


Fig. 58.

Fig. 57. Monochrome whorls from the first stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), p. 29, fig. 20: 1 (T95: 6A(8); 2 (T95: 5(18); 3 (T82: 5F(2); 6 (T149: 5(8); 7 (T165: 5(8).

Fig. 58. Polychrome whorls from the first stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), p. 29, fig. 20: 8 (T88: 5B, 5C, 5D(2); 9 (T89: 4(1)).

greyish-white, greyish-yellow, orange-yellow and greyish-brown colour, the painted ornaments were executed in a reddish-brown paint.[8.]

We can conclude that the whorls excavated from late period Chhü-chia-ling belong to the most important relics unearthed from the site. They indicate not only that the spindle-whorl was one of the most essential implements in this culture, but also supply us with an impression of the imaginative craftsmanship of their makers in the design and colouring of the ornamentation. Indeed, the repertoire of patterns created in Chhü-chia-ling was never surpassed on neolithic Chinese whorls and their powerful execution was never equalled in any other cultural region of China. They therefore represent far more than just the working utensils of daily life.

The Chhü-chia-ling cultural site of Shih-chia-ho[1] near Thien-men[2] in Hupei yielded small spindle-whorls with a diameter of two to three centimetres and a thickness of about 0.5 cm.[b] They are decorated not only with the 'whirlpool' and other already known patterns but also bear the *thai-chi*[3] design[0]—a new ornament on whorls.[d] They can be regarded as contemporary with Chhü-chia-ling whorls from the second stage of the later period (Fig. 64).

The site of Shih-lung-kuo-chiang[4] in Ching-shan county, produced one whorl,[e] and in Honan province at the Chhü-chia-ling cultural site of Hsia-wang-kang[5] in Hsi-chhuan[6], near to the Hupei province border, several pottery whorls were excavated.' A few whorls were also discovered at the site of Meng-hsi[7], Li[8]

» *Ibid.*, p. 48. [b] Anon. *(686)*, p. 14, fig. 2, fig. 3; pi. 2: 1-5. Cheng (16), p. 34, fig. 23.
[c] Anon. *[686)*, p. 14, fig. 3, the four whorls on the left side in the top line.
[d] A diagram which is traditionally understood as a representation of the *Yin* and *Yang* elements.
[e] Wang Chin, Wu Jui-Sheng *(1)*, pp. 41-6, fig. 1.
' Anon. (655), p. 9, fig. 7: 1 ; p. 10, fig. 9: 8; p. 12, fig. 13: 5.

[1] 石家河 [2] 天門 [3] 太極 [4] 石龍過江 [5] 下王崗
[6] 淅川 [7] 夢溪 [8] 澧



Fig. 59. Polychrome whorls from the first stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), pl. 1: 7 (56GC(63)); 8 (T12: 2(2)).

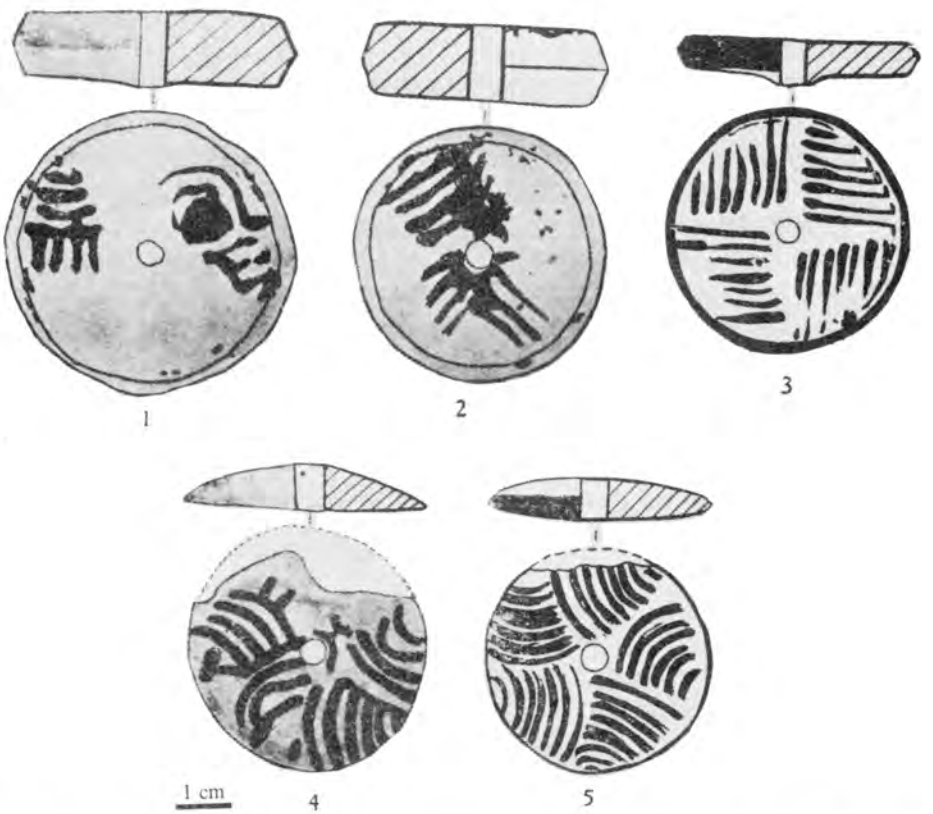


Fig. 60. Polychrome whorls from the first stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), p. 30, fig. 21: 1 (T12: 2(2)); 2 (T28: 5(2)); 3 (T88: 5A, 5C, 5D(2)); 4 (same reference); 5 (T81: 4(1)).

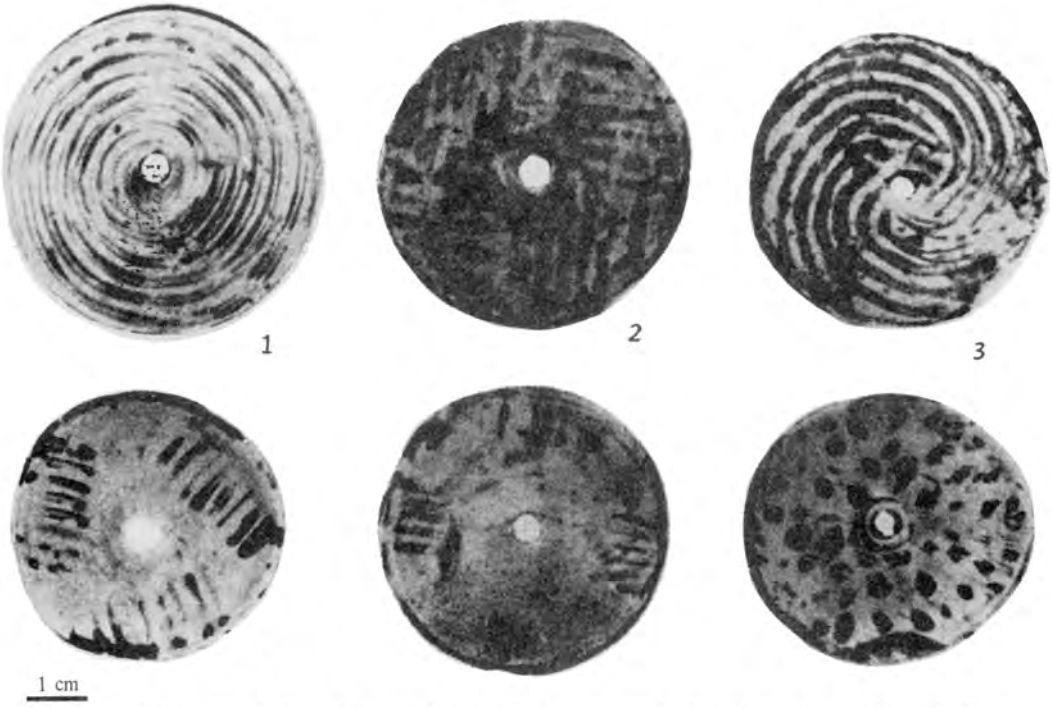


Fig. 61. Polychrome whorls from the second stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), pl. II: 1 (T104: 4(1)); 2 (T56: 2(1)); 3 (T94: 4(1)); 4 (T120: 3(39)); 5 (T106: 4A(3)); 6 (T115: 4(1)).

county in northern Hunan[a] while from the site of Thang-chia-kang *, An-hsiang[2] county seven pottery whorls were discovered.[13] They are all red and either fine or coarse structured, but no measurements are given.[0] From the final phase of the Chhü-chia-ling culture at the site of Kuan-miao-shan[3] in Chih-chiang[4] county, Hupei province[d] two red-coloured[e] and one orange-coloured pottery whorl[f] were excavated (Fig. 65). Both samples measure some 3.5 cm in diameter and 0.5 cm in thickness. They are decorated with a vivid geometric design of parallel lines.

The site of Ta-hsi[5], Wu-shan[6] county, Szechwan province, also belongs to the Chhü-chia-ling culture.^ An earlier series of excavations had already yielded spindle-whorls,[h] but a third series, conducted between October 1975 and January 1976, produced others from the two stages into which the layer can be divided[1]

a Anon. *{708)*, pp. 31-8; p. 34, fig. 11: 4; p. 38, fig. 16: 11 +13.
b Anon. *{680)*, pp. 341-54; p. 352. [c] *Ibid.*, p. 352.
[d] Anon. *{685)*, pp. 289-97.
[e] *Ibid.*, p. 295, (31 ®: 10), (T39 (3): 38).
[f] *Ibid.*, p. 295, no further information is provided.
& Cheng (16), p. 32; Chang (1), pp. 202-3.
* Anon. *{748)*, pp. 15-21, 60; esp. p. 16, p. 17, fig. 4: 13.
[1] Fan Kuei-Chieh (/), pp. 461-90.

[1] 湯家崗 [2] 安鄉 [3] 關廟山 [4] 枝江
[5] 大溪 [6] 巫山

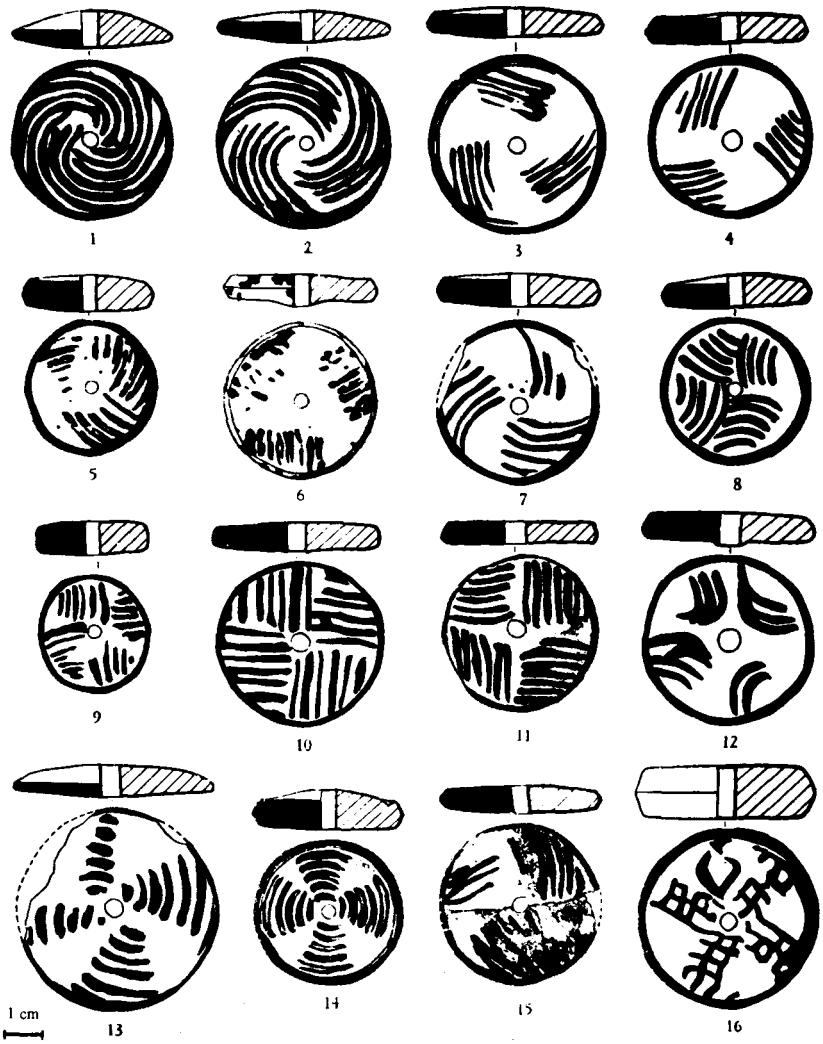


Fig. 62. Polychrome whorls from the second stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), p. 47, fig. 37; 1, 'radiating whirlpool' pattern *fu-she hsüan-wo-wen*[1] (T83: 4(1)); 2, 'three groups (of lines in parallel forming) a whirlpool' pattern *san-tsu hsüan-wo-wen*[2] (T97: 4(3)); 3, 'straight lines (arranged in) three groups' pattern *san-tsu chih-hsien-wen*[3] (T107: 4B(1)); 4, *Ibid.* (T52: 3(2)); 5, *Ibid.* (T102: 3A(3)); 6, *Ibid.* (T120: 3(29)); 7, see above, no. 2 (T65: 2(9)); 8, 'bowstrings (arranged in) four groups' pattern *ssu-tsu hu-hsien-wen*[4] (T83: 4G(1)); 9, 'straight lines (arranged in) four groups' pattern *ssu-tsu chih-hsien-wen*[5] (T88: 3D(1)); 10, *Ibid.* (T56: 2(1)); 11, *Ibid.* (T116: 3(2)); 12, 'bowstring' pattern *hu-hsien-wen*[6] (T90: 3(3)); 13, 'circles (formed of) four groups' pattern *ssu-tsu chhüan-wen*[7] (T96: 3C(1)); 14, *Ibid.* (T98: 4A(3)); 15, see above, no. 2 (T88: 3D(14)); 16, pattern painted in colour *tshai-wen*[8] (T105: 4(1)).

[1] 輻射旋渦紋 [2] 三組旋渦紋 [3] 三組直線紋 [4] 四組弧線紋 [5] 四組直線紋
[6] 弧線紋 [7] 四組圈紋 [8] 彩紋

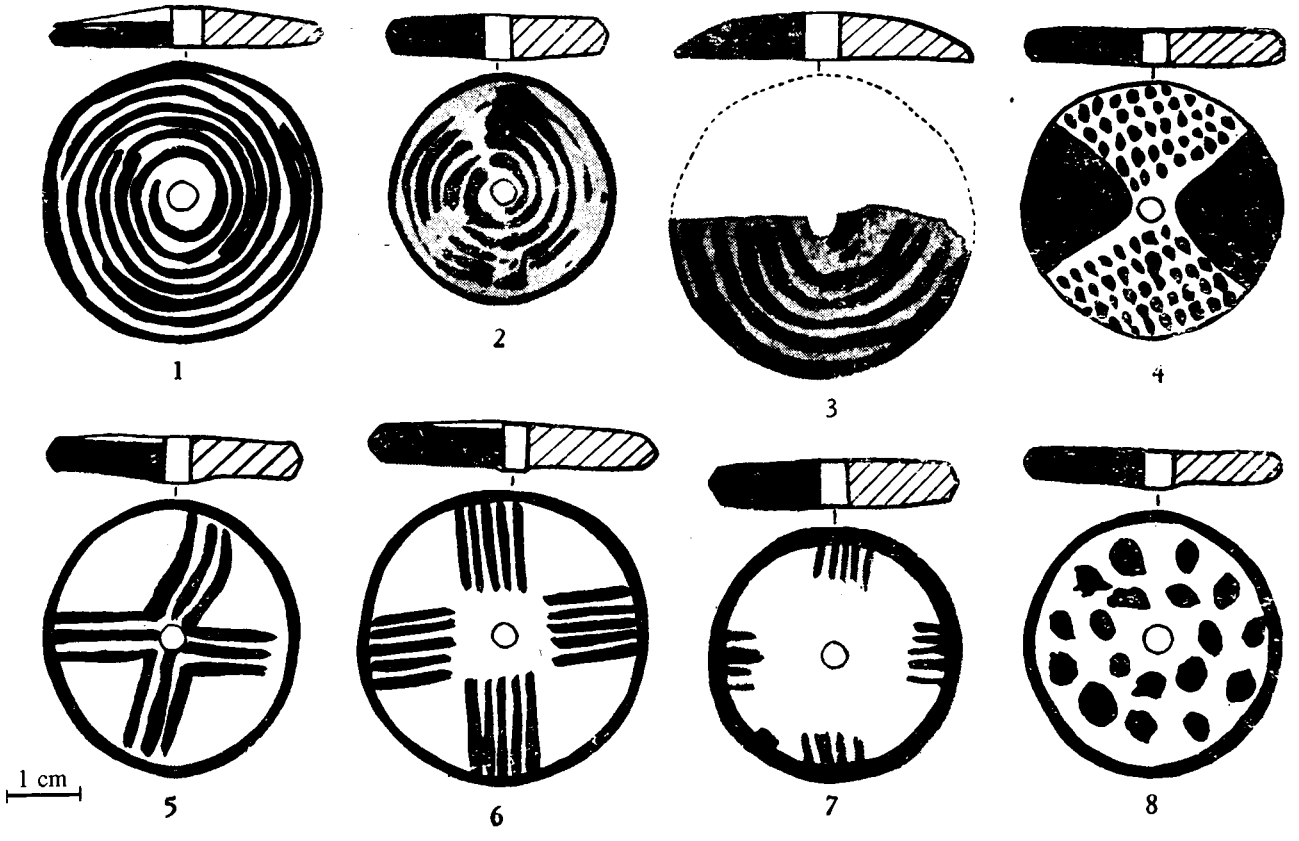


Fig. 63. Polychrome whorls from the second stage of the late period of Chhü-chia-ling, Chhü-chia-ling culture. Anon. (*630*), p. 47, fig. 37: 1, 'circle' pattern *yüan-chhüan-wen*[1] (T97: 4(4)); 2, *Ibid.* (102: 3A(5)); 3, *Ibid.* (T89: 4A(5)); 4, 'egg(-shaped) dots and triangles' pattern *luan-tien yü san-chiao wen*[2] (T92: 2(1)); 5, 'a shape like the character *shih*[3]' pattern *shih-tzu-hsing-wen*[4] (T133: 2(32)); 6, *Ibid.* (T132: 3D(7)); 7, *Ibid.* (T106: 4A(3)); 8, 'egg (-shaped) dots' pattern *luan-tien-wen*[5] (T89: 3D(1)).

[1] 圓圈紋　[2] 卵點與三角紋　[3] 十　[4] 十字形紋　[5] 卵點紋

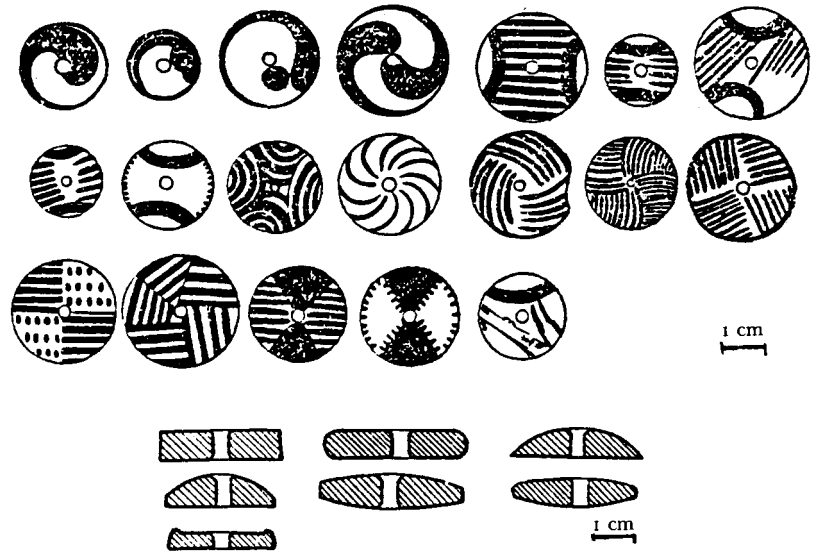


Fig. 64. Polychrome whorls from Shih-chia-ho, Chhü-chia-ling culture. Anon. (*686*), p. 14, fig. 3; p. 14, fig. 2.

(Fig. 66). Compared with the whorls excavated in Hunan and Hupei, the azechwan whorls are not attractive. They are made of pottery and bone,[a] and are larger than those from Hunan and Hupei.

The second season of excavations at the site of Liu-lin[1], located at Phi[2] county in northern Kiangsu,[b] brought six flat and round stone whorls[0] to light, as well as seven made of clay, six of the truncated cone type with a stepped structure and a diameter of up to 15 cm.[4] The stone whorls varied in size between 5.4 cm and 6.2 cm.[e]

Mention has already been made of the Chhing-lien-kang cultural site of Ta-tun-tzu in Kiangsu which also contained layers of Liu-lin and Hua-thing cultural artifacts. The Liu-lin culture had a limited distribution, confined to Kiangsu province, and its stone and pottery whorls are rather large and heavy. The stone whorls' are remarkably well-proportioned (Fig. 67), skilfully manufactured, with diameters of some 5.5 cm and between 1 cm to 2 cm thick. Their rims were sometimes decorated with an original geometrical pattern scratched on the surface (Fig. 68),[B] while the pottery whorls also display ornaments of a geometrical type (Fig. 69) .*

» ***Ibid.,*** p. 469, p. 468, fig. 16: 19, 2o(M79: 1, M94: 3); p. 470, fig. 17: 12, 13^94: 1, 2); p. **483,** fig-25:3.4(B:93»92)-

•> Anon. (625), pp. 9-48.

° *Ibid.*, p. 21, fig. 14: 5+6.

[a] *Ibid.*, p. 25, fig. 19: 1+2.

[e] *Ibid.*, p. 28, fig. 21: 4+6.

[1] Anon. *(626),* pp. xxx, p. 6: 5, p. 26, fig. 20: 1, 2 ([3]M3: 3, M8: 2).

f *Ibid.*, p. 26, fig. 20: 4 ([3]M2: 3).

" *Ibid.*, p. 37, fig. 32: 3, 4 ([3]M2o: 2; [3]M25: 1); ('30: 7; [3]M26: 7).

[1] 劉林 [2] 邳 [3] 大

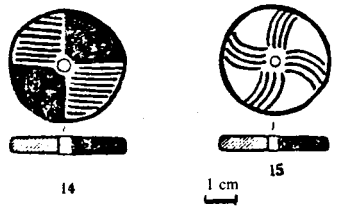


Fig. 65.

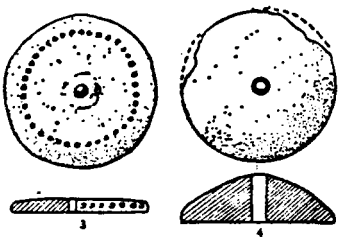


Fig. 66.

Fig. 65. Pottery whorls from Kuan-miao-shan, Chhü-chia-ling culture. Anon. (*685*), p. 295, p. 296, fig. 7: 14 (T31: ③ : 10); 15 (T39: ③ 38).

Fig. 66. Pottery whorls from Ta-hsi, Chhü-chia-ling culture. Fan Kuei-Chieh (*1*), p. 483, fig. 25: 3 (B: 93), 4 (B: 92).

The most important site of the Hua-thing[1] culture is Hua-thing-tshun[2] in Hsin-i[3], Kiangsu province,[0] though it produced only a few whorls, made of bone, pottery and stone.[b] A Hua-thing cultural layer was also discovered at the site of Ta-tun-tzu,° but the stone whorl found[4] lacks accuracy, measuring between 5 cm to 6 cm in diameter, depending on the points where the measurement is taken (Fig. 70). The site of Ta-wen-khou[4] in Thai-an[5] county, in southern Shantung, yielded bone whorls,[e] the site of Hsi-hsia-hou[6] in Chhu-fu[7] county produced only one spindle-whorl (Fig. 71).[1] Made of stone it measures about 5 cm in diameter and less than 1 cm in thickness. One pottery and one stone whorl were found also at the site of Yeh-tien[8] in Shantung.[8]

The Liang-chu[9] culture was a local Lung-shan culture confined to Chekiang and Kiangsu provinces,[11] and it may well be dated as belonging to the —3rd millennium.[1] One of its important sites was Chhien-shan-yang[10] in Wu-hsing[11] county, the lower layer of which yielded thirteen pottery whorls, the upper layer 29.[1] Spindle-whorls are also pictured in an article on ancient jade in the Liang-chu culture,[k] though regrettably what is shown does not make it possible to tell whether the whorls are made of jade or of a stone resembling jade. The site of Shui-thien-pan[I2] near Hangchou yielded one round flat whorl,[1] and the Liang-chu

a Chang (i), pp. 158-62; Cheng (17), p. no: Cheng observed that 'The male was **provided with stone** axes and bone harpoons; the female with bracelets and spindle whorls.'

t> Anon. *(678)*, pp. 23-6; esp. p. 25.

« Anon. *{626)*, p. 38, fig. 38: n (±Mi6: 4).

' Anon. *{731)*, pp. 57-106, esp. p. 100.

« Anon. *{736)*, pp. 25-30; esp. p. 26, p. 28, fig. 5.

[11] Chang (1), pp. 180-2; Cheng (16), pp. 36-7.

[1] Chang (1), pp. 180-1 : the Chhien-shan-yang stratigraphy has been seriously called into question, **but** placing the lower layer of the site in the — 3rd millennium may be considered safe.

I Anon. *{757)*, pp. 73-92.

[k] Anon. *{709)*, pp. 77-80; pi. 11: 4-5.

[1] Anon. *{651)*, pp. 93-106; esp. p. 101.

[c] See above, p. 96.

[e] Anon. *{750)*, p. 47.

[1] 花廳 [2] 花廳村 [3] 新沂 [4] 大汶口 [5] 泰安 [6] 西夏侯
[7] 曲阜 [8] 野店 [9] 良渚 [10] 錢山漾 [11] 吳興 [12] 水田畈

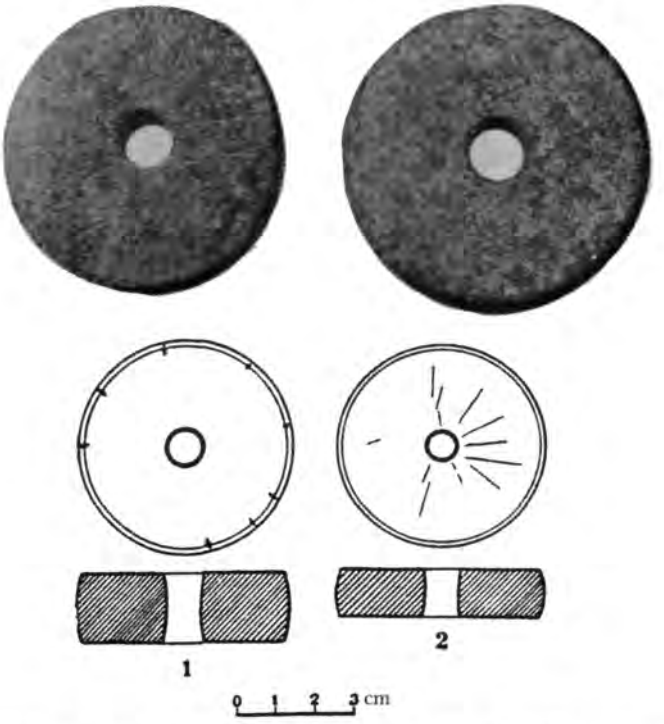


Fig. 67. Stone whorls from Ta-tun-tzu, Liu-lin layer. Anon. (*626*), pl. 6: 5; stone whorls (大 M8: 2; M3: 3); p. 26, fig. 30: 1, 2 (大 M8: 2; 大 M8: 3).

layer of the site at Ssu-tun[1], Wu-chin[2] in Kiangsu province yielded a fragment of a decorated pottery whorl measuring 4.5 cm in diameter and 1.7 cm in thickness.[8.]

Several Lung-shan sites in Shantung province contained spindle-whorls. Two pottery ones of a red colour, partly damaged, one of them measuring 4.8 cm in diameter and 1.7 cm in thickness, were excavated from the Lung-shan layer of the Tzu-ching-shan[3] site, Pheng-lai[4] county,[b] while the site of Yin-chia-chheng[5] near Ssu-shui[6] produced one dozen pottery whorls which do not all belong to the same layer.[0] It seems safe to say that those from layers five and four, six in all, are Lung-shan cultural remains (Fig. 72.16 + 17). Those from the third and second layers are more difficult to define, but should probably be categorised as Lung-shan.[4] One grey pottery whorl (Fig. 72.18) with a geometric pattern incised on the rim, bears a similarity to one from the Liu-lin cultural layer of Ta-tun-tzu, Kiangsu.[e] This is due not only to the pattern but also to the size; it is about 5.3 cm in diameter with a thickness of some 1.7 cm.

[a] Anon. *{627)*, PP- 193-200; esp. p. 196, fig. 6: 3. » Anon. *{732)*, p. 12, fig. 2: 5 + 6.
[0] Anon. *{734)*, p. 9, fig. 4: 17, one pottery whorl. Anon. *{735)*, p. 16, p. 13, fig. 3: 16, 17, 18.
[d] *Ibid.*, p. 17. [e] See above, Fig. 69.3.

[1] 寺墩 [2] 武進 [3] 紫荊山 [4] 蓬萊 [5] 尹家城
[6] 泗水



Fig. 68. Rim decoration of a stone whorl, Liu-lin layer. Anon. (*626*), p. 26, fig. 20: 4 (大 M2: 3).

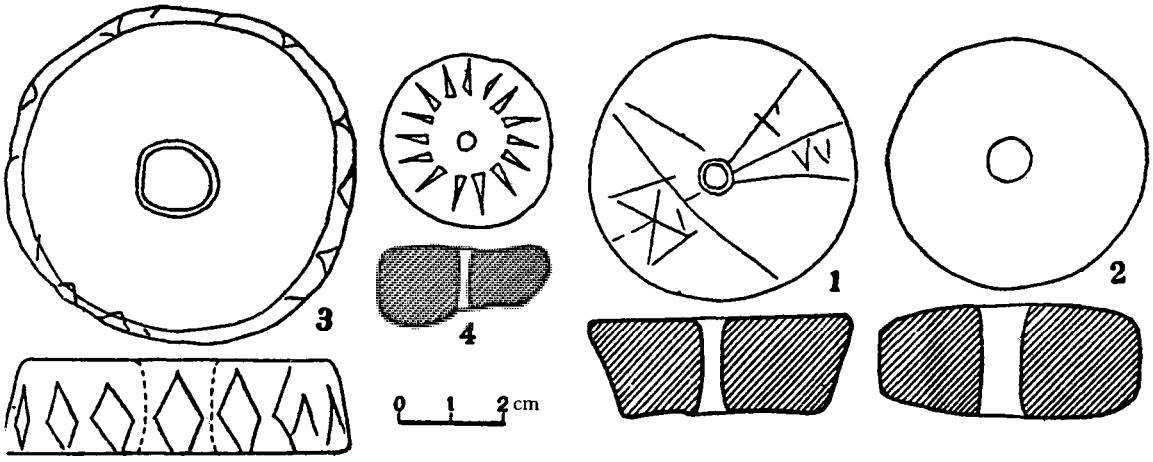


Fig. 69. Pottery whorls from Ta-tun-tzu, Liu-lin layer. Anon. (*626*), p. 37, fig. 32: 1 (大 M30: 7); 2 (大 M26: 7); 3 (大M20: 2); 4 (大M25: 1).

The Liang-chheng-chen[1] sites in Jih-chao[2] county yielded four pottery whorls of 5 cm and more in diameter,* while the lungshanoid assemblages at Ta-chheng-shan[3], Thang-shan-shih[4],[b] contained four examples also of pottery.[0] In addition, a site near Chang-chia-khou[5] in Hopei province produced three types of spindle-whorl.*

There is some reason for assuming that the local late neolithic culture at Chhing-chiang[6] in Kiangsi province was in touch with the typical Lung-shan tradition.[e] This is because of the yields of spindle-whorls found there. For instance, the sites at Chhing-chiang yielded ten examples made of pottery which may be divided into five types.[1] Made of gritty clay, they are comparatively small in diameter varying between 3.5 cm and 5.5 cm.[g] Moreover, no less than 92 whorls of extraordinary shape were found at the site of Ying-phan-li[7] at Chhing-chiang.[h] They all display a predilection for sharp pointed geometric shapes, and should be considered as exceptions from the general idea of how whorls should be designed (Fig- 73)-

[8] Anon. *{694)*, PP- 23» 25, fig- 4! P[1]- [6:] 4; three pieces. Anon. (695), pp. 32, 41, fig. 16: 3.
[6] Anon. (669), pp. 17-35. [c] *Ibid.*, p. 31, fig. 14: 8-11; pi. 7: 1.
[d] Anon. (688), p. 336. e Cheng (16), p. 35.
' Jao Hui-Yüan *(1)*, p. 57; pi. 10: 1.
e *Ibid.*, p. 57: I 1 piece 0 3.5 cm I 0.7 cm; II 1 piece 0 4 cm I 1.5 cm; III 6 pieces 0 4.6-5.5 cm I 1,a-i.5 cm; IV a pieces 0 4 cm I 1.4 cm. [h] Anon. *(620)*, p. 177, fig. 4: 1-8.

[1] 兩城鎮 [2] 日照 [3] 大城山 [4] 唐山市 [5] 張家口
[6] 清江 [7] 營盤里

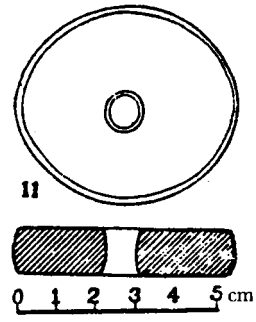


Fig. 70.

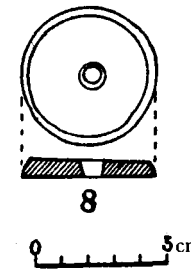


Fig. 71.

Fig. 70. Stone whorl from Ta-tun-tzu, Hua-thing layer. Anon. (*626*), p. 38, fig. 33: 11 (大M16: 4).
Fig. 71. Stone whorl from Hsi-hsia-hou, Hua-thing culture. Anon. (*731*), p. 100, fig. 28: 8 (M5: 3).

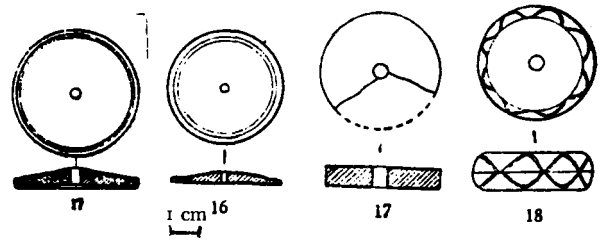


Fig. 72. Pottery whorls from Yin-chia-chheng, Lung-shan culture. 17 (left), Anon, (*734*), p. 9, fig. 4: 17. 16, 17, 18 (right), Anon. (*735*), p. 13, fig. 3: 16, 17, 18.

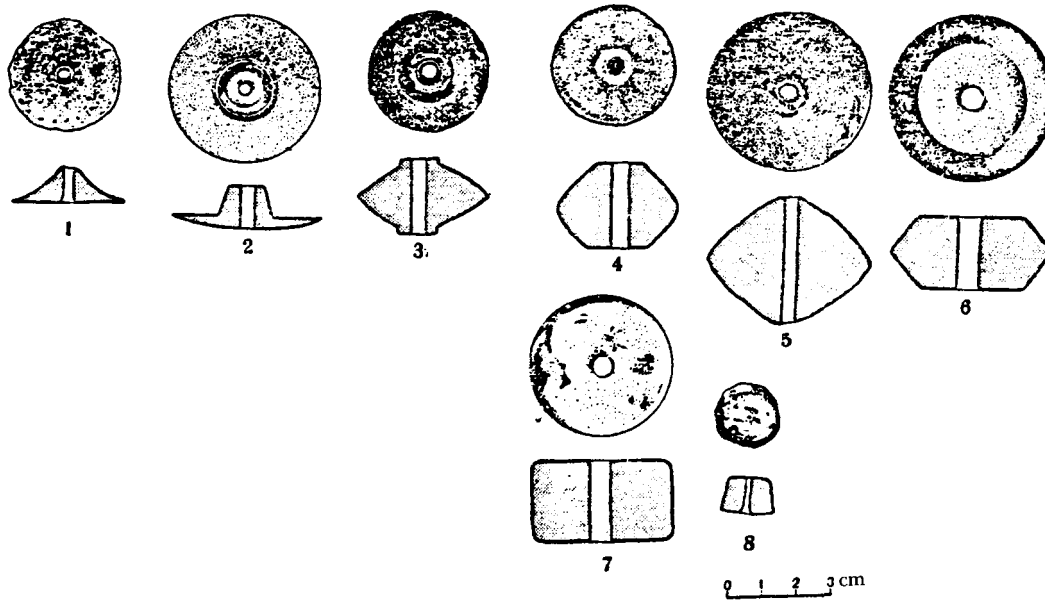


Fig. 73. Pottery whorls from Ying-phan-li, local Lung-shan. Anon. (*620*), p. 117, fig. 4: 1–8.

Another lungshanoid culture can be found in the south-east coastal region of China, in Fukien province. Neolithic sites dating from between —2000 and —500 are named after the Than-shih-shan[1] site at the mouth of the Min[2] River in northern Fukien. Although the sites are, as far as present evidence indicates, contemporary with the historic Shang dynasty in north China, many of the excavations still display the characteristics of a lungshanoid culture. For our purpose it is not necessary to distinguish its various phases because the region of the Feng-pi-thou[3] and Than-shih-shan cultures is confined to Taiwan and Fukien.[a]

Various periods of excavation at the Than-shih-shan site in Min-hou[4] county, northern Fukien, have unearthed many spindle-whorls.[1,] The upper layer, dating from the —ist millennium yielded 64 (Fig. 74), of which 48 were complete and 16 damaged.[0] The greater number is made of hard pottery clay of a grey and orange colour, and decorated with incised patterns or painted in colours. Most of the whorls are variations of the flat round disc-type, of which 50 are comparatively small in diameter—between 3.1 cm and 4.3 cm. One piece has an incised pattern looking like radiating *(fu-she*[5]*)* rays (Fig. 74.7),[4] another has impressed marks[e] of what seems to be dots or seeds (Fig. 74.8), while the painted whorls display linear geometric patterns. Sometimes the intention of the maker to paint a symmetrical ornament is obvious (Fig. 74.1, 2, 3, 5 +11).[f] Out of a total of 11 whorls, 6 are complete, and have waists larger in diameter than the top and bottom of the spindle.s Should the waist be smaller,[11] then the Chinese archaeologists have placed them into a third group. The middle layer, which radiocarbon dating shows as belonging to the end of the —2nd millennium,[1] produced 40 pottery whorls of gritty clay in grey, brownish-grey, yellow and other colours (Fig. 75),[3] again grouped as before into three classes. They show no signs of being painted but their surfaces are decorated with a needle-stitch pattern or a crosswise incised ornament.[k]

The lower layer contained only 11 spindle-whorls (Fig. 76). They have been divided into three groups, the first comprising three pieces which, in cross-section, are shaped like a lozenge. These are made of fine brownish-red or brownish-grey clay and are decorated on their surface with crosswise incisions, which Chinese archaeologists call *chih-chia-wen*[6] 'finger-nail-pattern' (Fig. 76.1).[1] The second type, comprising four pieces brownish-grey in colour, is smaller in size with a diameter of only 3.7 cm.[m] Again the diameter of their waists is larger than that of the upper and lowest parts (Fig. 77). Of the third type four pieces were also

[8] Chang (1), pp. 168-9, P- [!]73> table 8.

* In the excavation report from 1955 sixteen pottery spindle-whorls are mentioned. Anon. *{713),* p. 65. Anon. *(714),* pp. 83-118.

[c] *Ibid.,* p. 107.

e *Ibid.,* p. 107; fig. 24: 8.

« *Ibid.,* p. 108.

1 *Ibid., p.* 115; Chang (1), p. 489.

[k] *Ibid.,* p. 98, fig. 17: 4; pi. 14: 6.

m *Ibid.,* p. 91, (T132: 1).

* *Ibid.,* p. 107; fig. 24: 7.

1 Ibid., p. 108, fig. 1, 2, 3, 5, 11.

" *Ibid.,* p. 108.

I Ibid., pp. 97-8.

1 *Ibid.,* pp. 91-2.

[1] 疊石山 [2] 岷 [3] 鳳鼻頭 [4] 閩侯 [5] 輻射 [6] 指甲紋

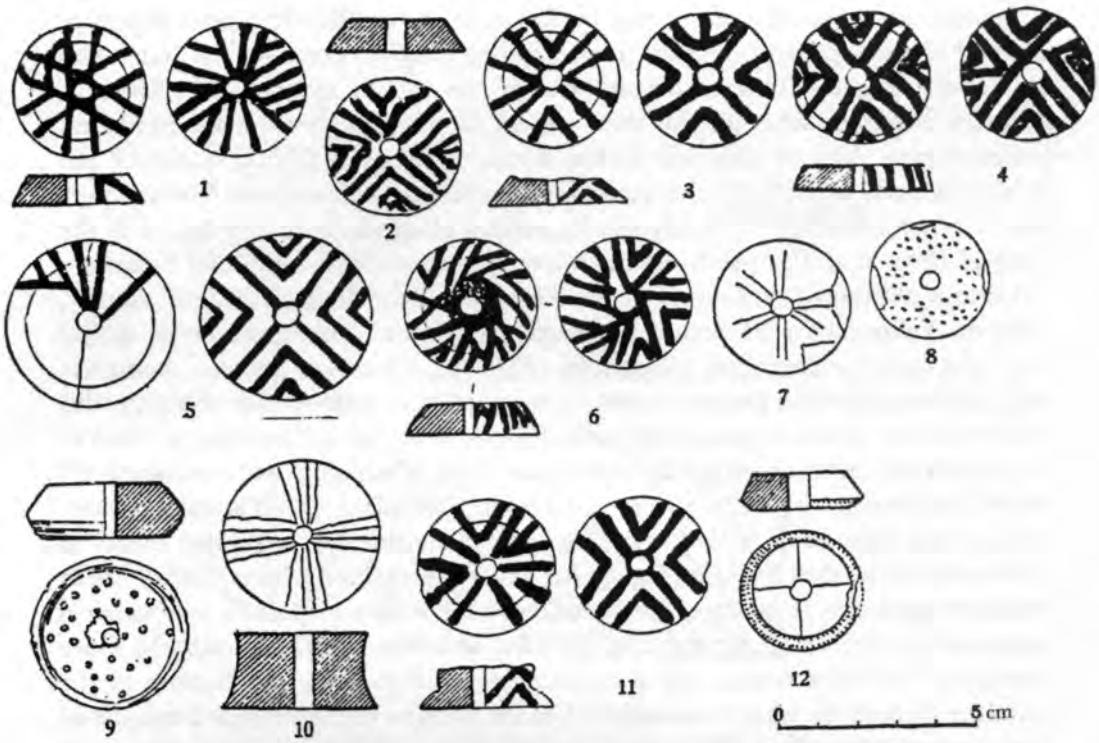


Fig. 74. Pottery whorls from Than-shih-shan, Lungshanoid. Anon. (*714*), p. 108, fig. 24 (upper layer): 1 (T118: 11); 2 (T114: 1); 3 (T115: 2); 4 (T118: 10); 5 (T116: 6); 6 (T115: 1); 7 (T120: 7); 8 (T129: 3); 9 (T116: 1); 10(采: 16); 11 (T117: 9); 121(T126: 4).



Fig. 75. Pottery whorls from Than-shih-shan, Lungshanoid. Anon. (*714*), pl. 16: 15 (T118: 10); 16 (T114: 1); 17 (T116: 1); 18 (T125: 4).

excavated.[a] They are described as being made of coarse sandy material and are flat discs with polished surfaces. Two of them may have been used as spindle-whorls but this cannot be determined for certain.

It should be noted that three layers of whorls at a site offer a very good idea of the evolution of their shapes and the designs on them. In all three layers we find a

[a] *Ibid.*, p. 92.

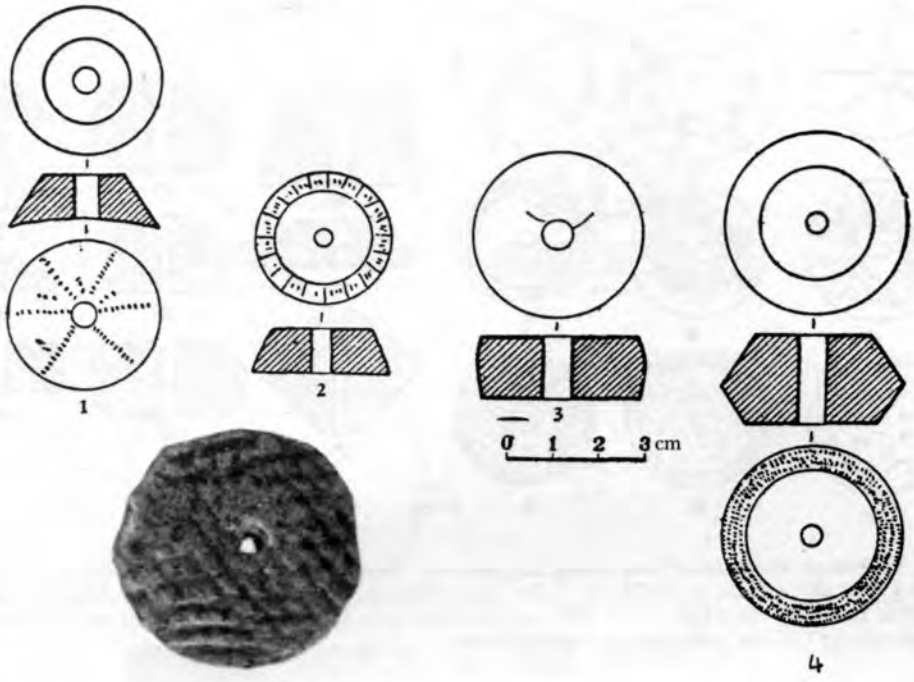


Fig. 76. Pottery whorls from Than-shih-shan, Lungshanoid. Anon. (*714*), p. 98, fig. 17: 1 (采: 22); 2 (M5: 4); 3 (T126: 35); 4 (T124: 3); pl. 14: 6 (T122: 6).

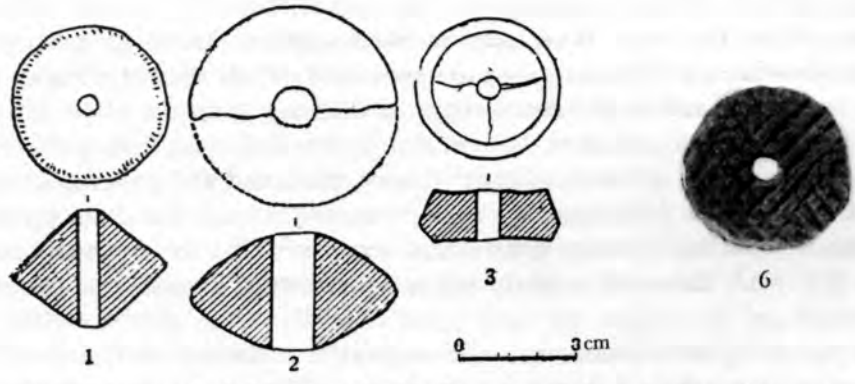


Fig. 77. Pottery whorls from Than-shih-shan, Lungshanoid. Anon. (*714*), p. 92, fig. 12: 1 (M11: 1); 2 (T125: 22); 3 (T132: 1); pl. 13: 6 (T132: 2); (lower layer).

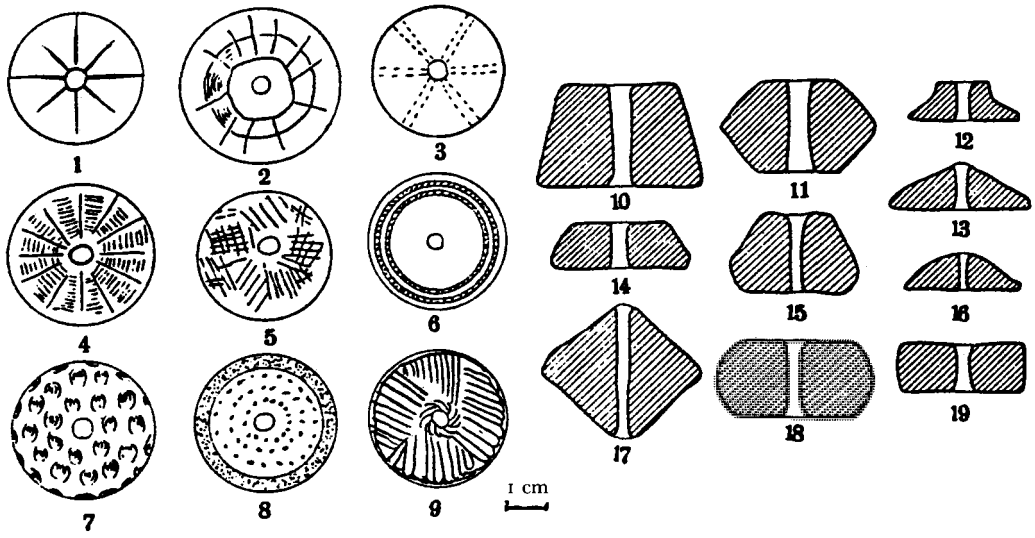


Fig. 78. Pottery whorls from Tung-chang, Lungshanoid. Anon. (*649*), p. 60, fig. 14 (T103: 11); 2 (T10: 55); 3 (T6: 48); 4 (T10: 5); 5 (T6: 5); 6 (T4: 6); 7 (T3: 37); 8 (T10: 17); 9 (T6: 26). Whorls in cross-section: p. 60, fig. 10 (H18: 1); 11 (T6: 46); 12 (T10: 51); 13 (T7: 8); 14 (T9: 2); 15 (T7: 12); 16 (T48: 15); 17 (T6: 62); 18 (T54: 4); 19.

type where emphasis is put on the 'waist' rather than the top or bottom of the whorl. As far as can be judged from the report, the whorls were never large, and became even smaller from the lower to the upper layer. Decorative imagination increased considerably beginning with the very simply incised patterns found on the whorls from the lower layer, to the needle-stitch pattern of the middle layer and the geometrically painted designs of the upper.

From various sites near Wu-phing[1] in south-western Fukien 42 pottery soft clay spindle-whorls in red and grey were excavated. Their diameter varies from 2.4 cm to 5.8 cm, and they have a range of thickness from 2.1 cm to 3.8 cm." Three whorls were found at the site of Fu-tshun[2], Fu-chou[3],[b] while the lower layer of Tung-chang[4] site in Fu-chhing[5] county, produced 226 pottery examples, decorated in various ways and of different shapes but all less than 4.5 cm in diameter, the smallest measuring 2.8 cm in diameter and only one centimetre in height (Fig. 78).° The middle and the upper layers yielded another 108, also made of pottery.[d]

Five pottery spindle-whorls were also excavated at the sites of Chien-ou[6] and Chien-yang[7] in northern Fukien.[e] Yet it is not only the sites in northern Fukien, but also those in the south of the province which display an imaginative craftsman-

» Anon. (650), p. 184.
[b] Anon. *{646)*, p. 24, fig. 6: 5, 6, 7.
[c] Anon. *{64g)*, p. 60, fig. 14: 1-19.
[d] *Ibid.*, p. 60, fig. 14: 12.
[e] Anon. *(716)*, p. 192, fig. 6: 1-4.

[1] 武平 [2] 浮村 [3] 福州 [4] 東張 [5] 福清 [6] 建甌
[7] 建陽

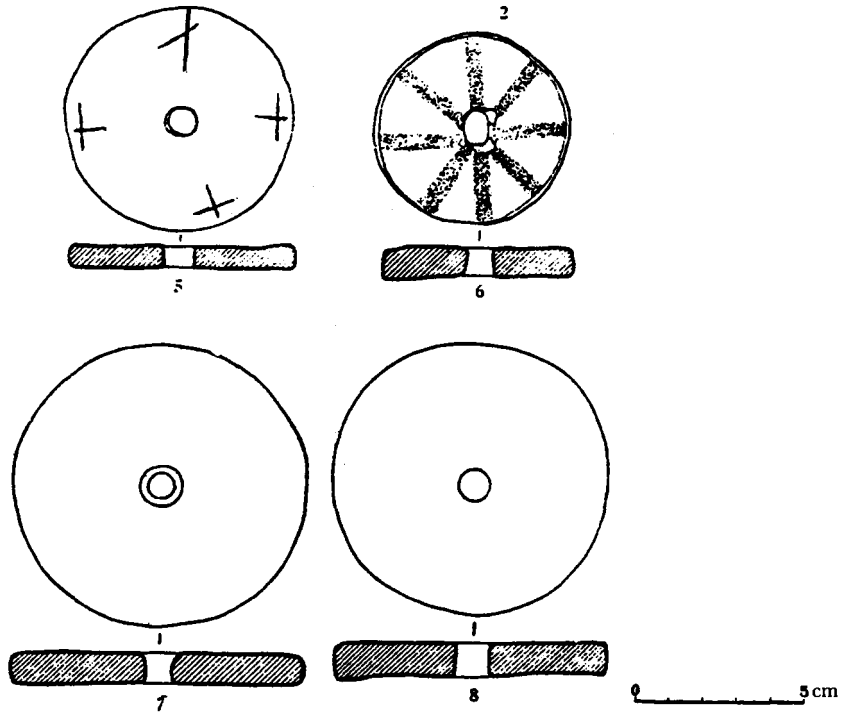


Fig. 79. Pottery and stone whorls from Ti-pa-phing, Pan-shan Yang-shao. Anon. (*702*), p. 198, fig. 8: 5 (stone, 58: 18); 6 (pottery, 36: 8); 7 (stone, 35: 10); 8 (pottery, 13: 7).

ship in the manufacture of pottery whorls,[a] as is admirably demonstrated by a few examples excavated from Shih-tzu-shan[1], Feng-chou.[b]

Compared with the Fukien spindle-whorls, those excavated in Ti-pa-phing[2] in Kuang-ho[3] county in the north-western province of Kansu are very simple.[0] The site, dated about — 2500 and so roughly contemporary with the lower layer of the Than-shih-shan site, yielded four whorls, two of pottery and two made of stone (Fig. 79). They are flat round discs, measuring between 5.5 cm and 8.8 cm in diameter, and are between 0.6 cm and 1 cm thick. The stone whorls are polished on one side while the other side remains rough, and one whorl is decorated **with four** cross-shaped signs similar to the Chinese character *s/nh** (Fig. 79.5).[d] The pottery whorls do not differ in shape from the stone ones, but there is one which has a pattern drawn on the surface in black, and resembling the Chinese character *mi*[5] (Fig. 79.6).[6] The Chhi-chia[6] culture of Kansu province which

» Anon. *{715)*, p. 241, fig. 3: 1-3. Yang Chhi-Chheng (i), p. 44, fig. 1: 8, 9, 10. Anon. *{647)*, p. 41; pi. 2: 3-16.

" Anon. *{648)*, p. 195, fig. 1: 4, 7, 9; p. 196.

" *Ibid.*, p. 198, fig. 8: 5 (stone, 58: 18).

o *Ibid.*, p. 198, fig. 8: 6 (pottery, 36: 8).

[c] Anon. *{70s)*, pp. 193-210.

[1] 獅子山 [2] 地巴坪 [3] 廣河 [4] 十 [5] 米 [6] 齊家

followed the Yang-shao is dated as lying between the last centuries of the — 3rd millennium and the contemporary flourishing Shang dynasty in Honan province." A number of sites yielded whorls, most of them in Yung-ching[1] county (Fig. 80). The site of Ma-chia-wan[2] produced one flat and extremely thin pottery whorl being only 0.6 cm thick, but with a diameter of 7.6 cm,' though its shape is not perfectly round.

The Chhi-chia culture remains of Chang-chia-tsui[3] and Chi-chia-chhuan[4] contained spindle-whorls made of both stone and pottery.[0] Two pottery whorls measure 10 cm in diameter and 2 cm in thickness ;[d] they are flat but display a peculiarity. The hole through which the spindle-shaft perforates the whorl opens out at both top and bottom. The two stone whorls found were heavily damaged. They are big and flat, measuring 7.7 cm in diameter but only 0.5 cm in thickness.[6] The Hsin-tien[5] cultural layer of Chang-chia-tsui contained 8 whorls varying in diameter from 4.3 cm to 9.1cm. The sample pictured measures 6.6 cm in diameter, is 1.8 cm thick,[1] and shows the same peculiar shape of hole to take the spindle-shaft.[g]

Fifty-six pottery whorls were excavated at the site of Ta-ho-chuang[6].[h] Nineteen belong to the 'beads of an abacus' *suan-pfian-chu*[7] type,[1] 26 are of convex shape^ and 11 are flat discs.[k] All examples are over 5 cm in diameter. Some are decorated with dot- or stroke-like incised patterns of a simple kind, but regrettably no complete sample of a decorated whorl has survived.

Few spindle-whorls were discovered at the site of Huang-niang-niang-thai[8], Wu-wei[9] county. What there were, are made of pottery and stone and measure more than 5 cm in diameter.[1]

The spindle-whorls of Kansu province which are attributed to sites of the Yang-shao, Chhi-chia and Hsin-tien cultures are comparatively large and heavy. From the whorls alone we can tell that the quality of yarn spun must have been rather coarse, and in all probability the big whorls were driven and used for manufacturing cords and thin ropes.

The Kansu whorls are in strong contrast to the small and light whorls from contemporary sites in Fukien. They reflect the regional differences in yarn production but, more than that, their quality was determined to a considerable extent by the raw fibre material grown in the region and used for the manufacture of yarn. Various sites excavated at Kao-thai-shan[10] in Hsin-min" county also

» Chang (1), pp. 193-9; Cheng (16), p. 26.
" Anon. *(700),* p. 94; fig. 7: 4 (TA: 1); fig. 7: 5 shows an unfinished stone spindle-whorl.
[0] Anon. *{699),* PP- 187-220. a *Ibid.,* p. 190, fig. 5: i(Hs: 1).
e *Ibid.,* p. 208, fig. 19: 3(Hi8: 6). *1 Ibid.,* p. 193, fig. 7: 3^75: 1).
[B] *Ibid.,* p. 195, p. 194, fig. 9: 3($T_5$5: 6), 5(Hi7i : 3).
» Anon. (539), p. 47. ' *Ibid.,* p. 47, fig. 23: 4^3 : 2).
J *Ibid.,* p. 47, fig. 23: 5(T2i : 3). * *Ibid.,* p. 47, fig. 23: 6($T_4$8: 2).
1 Anon. *{697),* P- 62, fig. 6: 7; p. 65, fig. 9: 2^7(2)); 3(M2).

[1] 永靖 [2] 馬家灣 [3] 張家咀 [4] 姬家川 [5] 辛店
[6] 大河庄 [7] 算盤珠 [8] 皇娘娘台 [9] 武威 [10] 高台山
[11] 新民

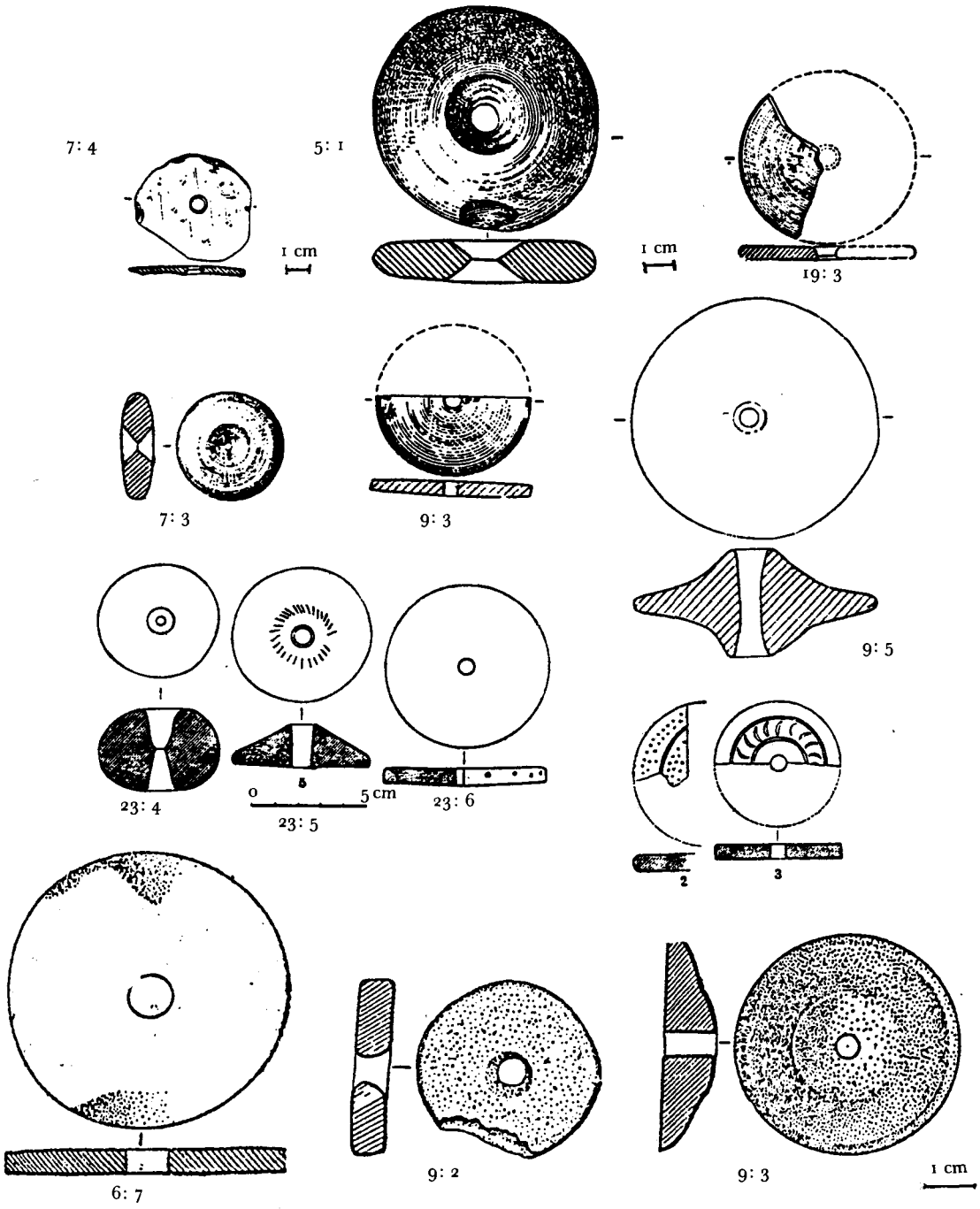


Fig. 80. Pottery and stone whorls from various sites in Kansu. Ma-chia-wan: 7: 4; Anon. (*700*), p. 94, fig. 7: 4 (TA: 1); Chang-chia-tsui: 5: 1; Anon. (*699*), p. 190, fig. 5: 1 (H5: 1); Chi-chia-chhuan: 19: 3; Anon. (*699*), p. 208, fig. 19: 3 (H18: 6); Hsin-tien layer: 7: 3; Anon. (*699*), p. 193, fig. 7: 3 (T75: 1, stone); Hsin-tien layer: 9: 3; Anon. (*699*), p. 194, fig. 9: 3 (T55: 6, pottery); Hsin-tien layer: 9: 5; Anon. (*699*), p. 194, fig. 9: 5 (H171: 3, pottery); Ta-ho-chuang: 23: 4, 5, 6; Anon. (*539*), p. 47, fig. 23: 4 (T3: 2); 5 (T21: 3); 6 (T48: 2). Ta-ho-chuang: 23: 2, 3; Anon. (*539*), fig. 23: 2 (T41: 9, fragment); 3 (T30: 18, fragment). Huang-niang-niang-thai: 6: 7; Anon. (*697*), p. 62, fig. 6: 7 (stone); 9: 2, 3; Anon. (*697*), p. 65, fig. 9: 2 (T7: 2); 3 (M2) (pottery).

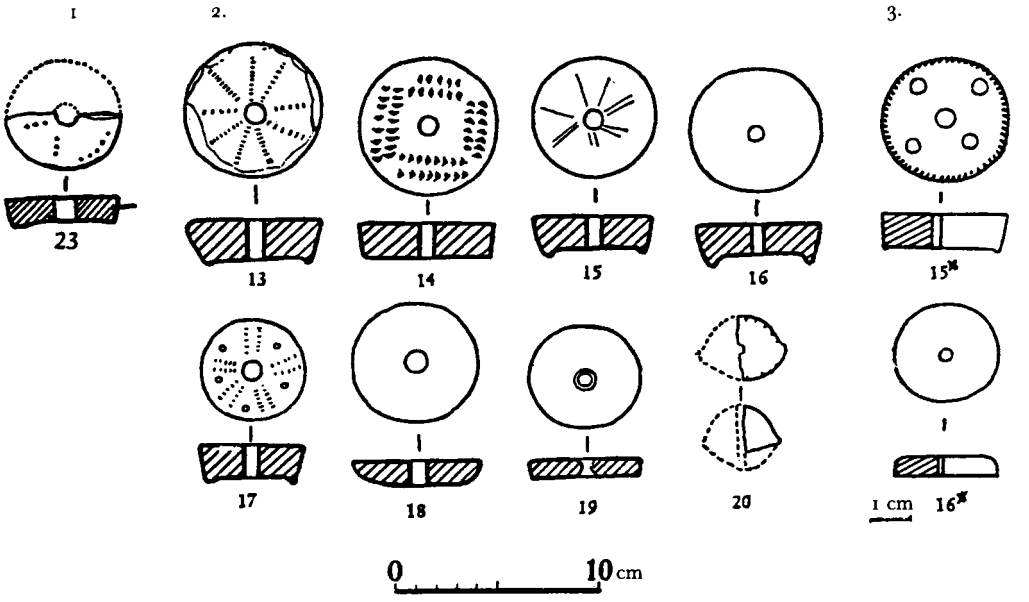


Fig. 81. Pottery whorls from Kao-thai-shan, Lungshanoid(?). 1, Tung-kao-thai-shan; Anon. (*737*), p. 127, fig. 7: 23 (S7414). 2, Yao-kao-thai-shan; *ibid.*, p. 125, p. 126, fig. 6: 13 (H731: 15); 14 (H731: 14); 15 (T743: 7); 16 (T743: 8); 17 (H732: 4); 18 (H732: 5); 19 (H732: 6); 20 (T743: 10). 3, Same site as 2, tomb M734; *ibid.*, p. 123, fig. 4: 15 (M734: 4); 16 (M734: 5).

produced whorls (Fig. 8i).[a] Though the lower layer of East Kao-thai-shan may be dated as belonging to the first half of the —3rd millennium^ it did not, unfortunately, contain any whorls, but the upper layer produced one damaged flat disc-shaped example in pottery (Fig. 8i.i).[c] From the site at Yao-kao-thai-shan[1] nine spindle-whorls were reported (Fig. 8i.2).[d] Seven of them were of the flat disc-type measuring between 4.5 cm and 6 cm in diameter,[0] but two have been reconstructed as bead type whorls.' They are decorated on the surface with simple impressed patterns. Two pottery spindle-whorls of the flat disc-type were discovered also in the tomb no. M734 at the Yao-kao-thai-shan site (Fig. 81.3).[8] The remains excavated at the Kao-thai-shan site bear lungshanoid features.

Mei-shan[2] site, which is in Lin-ju[3] county in Honan province, was excavated in 1975.[11] Apart from Erh-li-thou[4] cultural phases, two of late period Lung-shan[5] culture could be recognised, each with its own features. A radiocarbon dating gives a range of between —2290 and —2005 for the Lung-shan remains bringing them well within the period of the so-called Hsia[6] dynasty.

[a] **Anon. *{737)*, pp. 121-9.**
[c] ***Ibid.*, p. 127, fig. 7: 23(87414).**
[e] ***Ibid.*, p. 125.**
[f] ***Ibid.*, p. 122, p. 123, fig. 4: 15, 16.**
[*] ***Ibid.*, p. 129.**
[d] ***Ibid.*, p. 125, p. 126, fig. 6: 13-20.**
[g] ***Ibid.***
[h] **Anon. *(659)*, pp. 427-76.**

[1] 腰高台山 [2] 煤山 [3] 臨汝 [4] 二里頭 [5] 龍山
[6] 夏

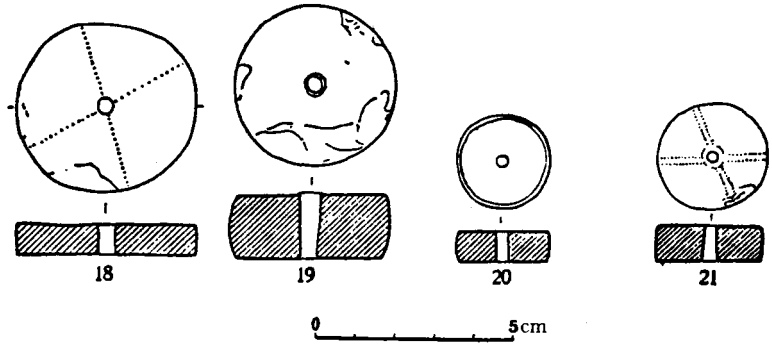


Fig. 82. Pottery whorls from Mei-shan site, Lung-shan culture. Anon. (*659*), p. 454, fig. 22: 18 (H60: 2); 19 (H51: 5); 20 (T18 ③ : 1); 21 (T2 ⑤ A: 2).

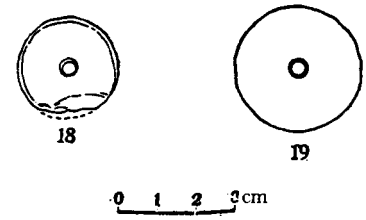


Fig. 83. Whorls of bone and clam-shell from Mei-shan, Lung-shan culture. Anon. (*659*), p. 456, fig. 24: 18 (clam-shell, H67: 1), 19 (bone, T16 ③ : 4).

The whorls found there are few and of the well-known disc-type, as well as another type with a bow-shaped rim (Fig. 82).[a] Two samples are of special interest: they have diameters of 4.6 cm and 2.8 cm and display on their respective surfaces a single line 'hemp-dot-pattern' *(hsiao-ma-tien-wen*[1]*)* in the shape of the Chinese character *shih*[2], and a double line 'hemp-dot-pattern' of the same general appearance.[b] There are also simple, unpatterned whorls.[0] Spindle-whorls made of clam-shell or bone, are reported as well (Fig. 83) ; they measure 3 cm or less and are very fine in structure."[1]

The first phase of the Erh-li-thou layer yielded a pottery whorl measuring 3.9 cm in diameter, decorated with a pattern in the shape of the Chinese character *shih*[2], executed in straight double lines.[e] This appears to be a continuation of the pattern executed in dot-lines from the Lung-shan layer.

[a] *Ibid.*, p. 441, p. 440, fig. 12: 28($T2_5$ (§) B: 6); $_{29}$(T_2 (5) C: 1).
" *Ibid.*, p. 453, p. 454, fig. 22: I8(H6<K 2); 21 (T2 (5) A: 2).
[c] *Ibid.*, p. 454, fig. 22: ig(H5i: 5); 2o(Ti8(D : 1.
[d] *Ibid.*, p. 458, p. 456, fig. 24: i8(clam: H67: 1); i9(bone: T16 (3) : **4).**
[e] ***Ibid.*, p. 464, fig. a8: 24(1113: 7).**

[1] 小麻點紋 [2] 十

(iii) *Other Neolithic Sites Yielding Spindle-whorls Contemporary with Historic Periods*

Apart from the sites mentioned, there are many others whose remains cannot easily be attributed to one or other neolithic culture or cultural phase. What they all have in common is that they are located in the 'classical' regions recognised by Chinese archaeologists, and exhibit the characteristics of neolithic craftsmanship, even though the Bronze Age had already started and was flourishing under the contemporary Shang dynasty.

Two pottery whorls were excavated at the site of Ho-wang[1], Hsing-yang[2] in Honan province,* and twenty-eight pottery whorls were found in the upper layer of Mao-tshao-ssu[3], Thang-ho* county (Fig. 84.1) .[b] The clay is gritty, the colour grey, and they measure between 4.3 cm and 5.5 cm, if we can take the samples pictured as average." The site of Chai-tzhu-kang,[5] Thang-ho county, yielded 87 pottery whorls, conventional in type, measuring between 3.5 cm and 4.5 cm in diameter (Fig. 84.2).* Again, the upper and lower layer of the neolithic site of San-so-lou[6] at Pan-chhiao[7], Mi-yang[8] county, produced 11 pottery whorls (Fig. 84.3)^ while 25 were found at Ching-shu-fen", Pan-chhiao (Fig. 84.4)[1]. These are either of the shape of flat discs, or of convex and double trapezium type, and are coloured grey or red.

Three other pottery whorls, two of which resemble lozenges in cross-section, were excavated at Ku-shui-ho[10] and can be attributed to the second phase of the Wang-wan[11] cultural period (Fig. 84.5).[8]

At the site of Kuang-she[12], Thai-yüan[13] in Shansi province, four pottery and one stone whorl were found,[h] and in Shantung province several sites contained whorls, but not many and what there were turned out very often to be damaged.[1]

From Kiangsu province we know of a neolithic site Kuang-fu-lin[14] in Sung-chiang[15] county which yielded one pottery whorl.[1] Pottery whorls were also found at San-li-tun[16], Hsin-i[1]'county, Kiangsu province.[k] Again, during the first excavation at Pei-yin-yang-ying[18]near Nanking in Kiangsu, 12 stone whorls were found as well as 15 made of pottery.[1] In the second excavation 33 stone and 62 pottery whorls were discovered.

» Anon. *{658),* p. 95, fig. i : 10.
» Anon. *{666),* p. 3) fig. 3: 8(T_5: 68), io(T_5: 12).
[4] Anon. *{665),* P- 643, fig. 6: i(T2: 9), 2(Ti : 4).
' *Ibid.,* p. 438, fig. 9: 18-21.
0 *Ibid.*
[e] Anon. *{661),* p. 436, fig. 4: 12.
[g] Anon- ([ff]39). P- 30. [fi]g- 9: 1-3-
[11] Anon. *{704),* p. 29, fig. 3: 10; p. 32, fig. 6.
' Anon. (730), p. 372, fig. 2: 30. Anon. *{733),* p. 512, fig. 5; fourteen pottery whorls were found. Anon. *(729),* p. 530, fig. 2: 20, one whorl, made of stone, was excavated. Anon. (653), p. 480, fig. 1: 19-21.
J Anon. *{727),* p. 468, fig. 5: 5; pi. 3: 11.
[k] Chiang Tsuan-Chhu (1), p. 11.
' Anon. (7/0), p. 19; pi. 15: 6.

[1] 河王 [2] 荥陽 [3] 茅草寺 [4] 唐河 [5] 寨茨崗
[6] 三所樓 [7] 板橋 [8] 泌陽 [9] 荆樹坟 [10] 谷水河
[11] 王灣 [12] 光社 [13] 太原 [14] 廣富林 [15] 松江
[16] 三里墩 [17] 新沂 [18] 北陰陽營

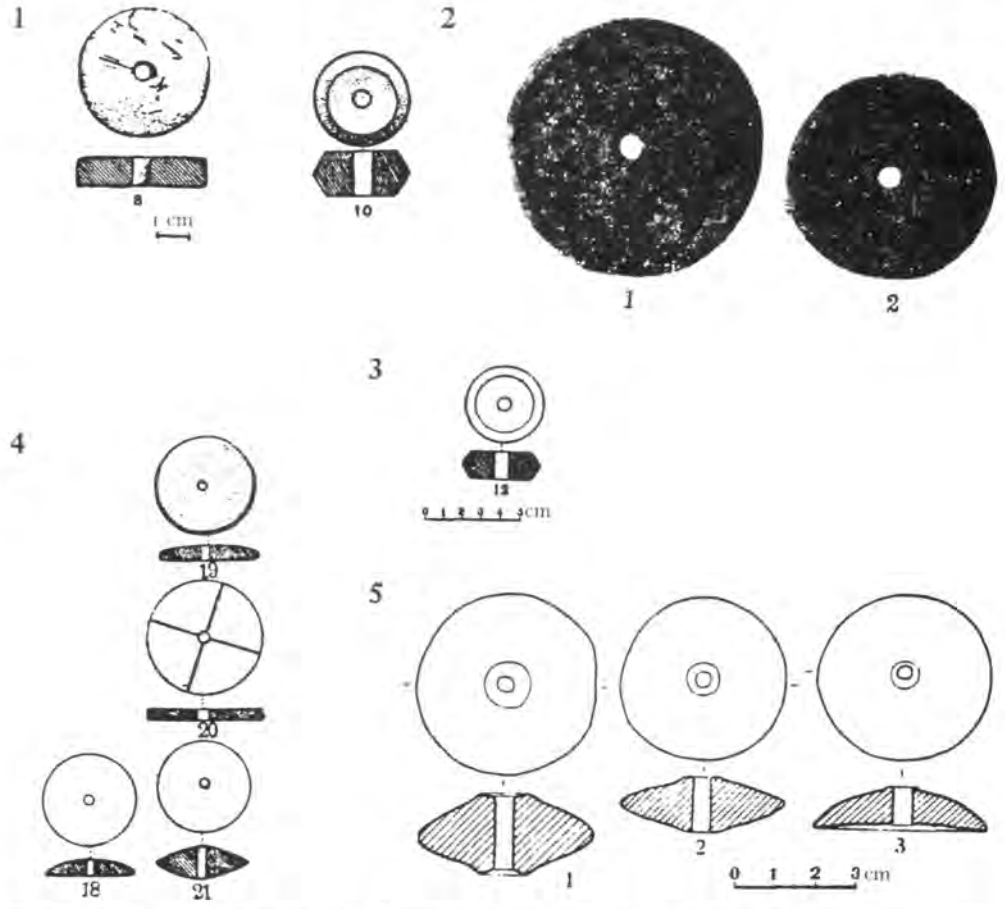


Fig. 84. Pottery whorls from neolithic Honan. 1, Anon. *(666)*, p. 3, fig. 3: 8 (T5: 68); 2, Anon. *(665)*, p. 643, fig. 6: 1 (T2: 9); 2 (T1: 4); 3, Anon. *(661)*, p. 436, fig. 4: 12; 4, *Ibid.*, p. 438, fig. 9: 18–21; 5, Anon. *(689)*, p. 30, fig. 9: 1–3.

At the site of So-chin' village, Nanking, six spindle-whorls made of stone[a] and thirteen pottery whorls of three types were excavated (Fig. 85).[b] One piece of the double trapezium type measures 4.5 cm in diameter at the waist and has a thickness of one centimetre.[0] The flat disc-type whorls measure between 3 cm and 4.5 cm in diameter.[d] In addition, three were found at the site of Tung-yang heng-tien[z] in Chekiang province,[e] one at the site of Hua-chia-ssu[3], Hsiao[4] county, Anhui province.[1] A pottery spindle-whorl was excavated at Huang-shih[5] city in

*' Yin Huan-Chang (/), p. 2: 24-5.

[b] *Ibid.*, p. 24, fig. 6: 1, 2, 3; pi. 4: 9-12; pi. 4: 13 pictures an unfinished whorl. It has the shape of an unperforated disc.

[c] *Ibid.*, p. 23, not pictured.

[d] *Ibid.*, p. 24, fig. 6: 2.

[e] Tang Hua *(1)*, p. 75, pi. 11; three whorls 0/1 3.2/1.5; 4/2.5; 4.5/4 cm.

[1] Anon. (600), p. 60; one whorl 0/1 6.3/0.95 cm.

[1] 新合 [2] 永陽橫山 [3] 花家寺 [4] 宿 [5] 黃石

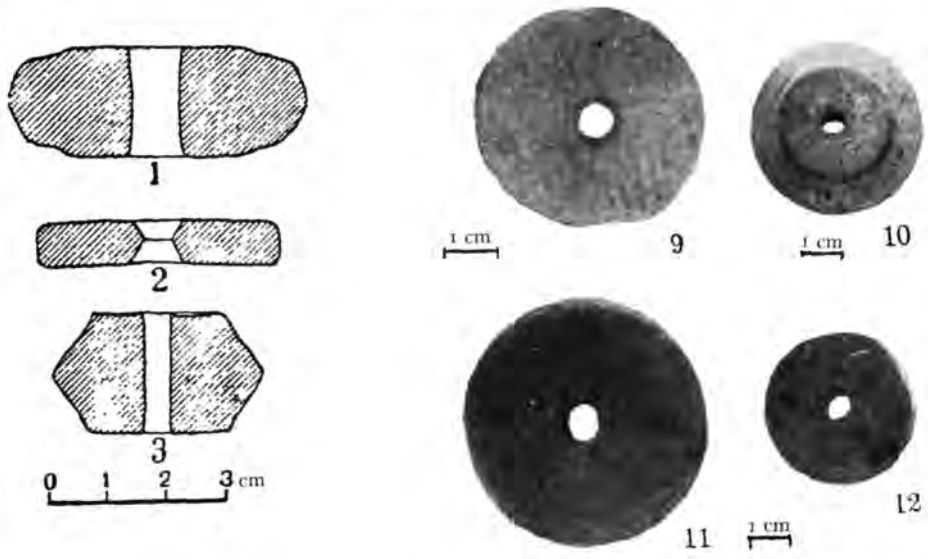


Fig. 85. Pottery whorls from So-chin-tshun, Nanking. Yin Huan-Chang (*1*), p. 24, fig. 6: 1, 2, 3; pl. 4: 9–12.

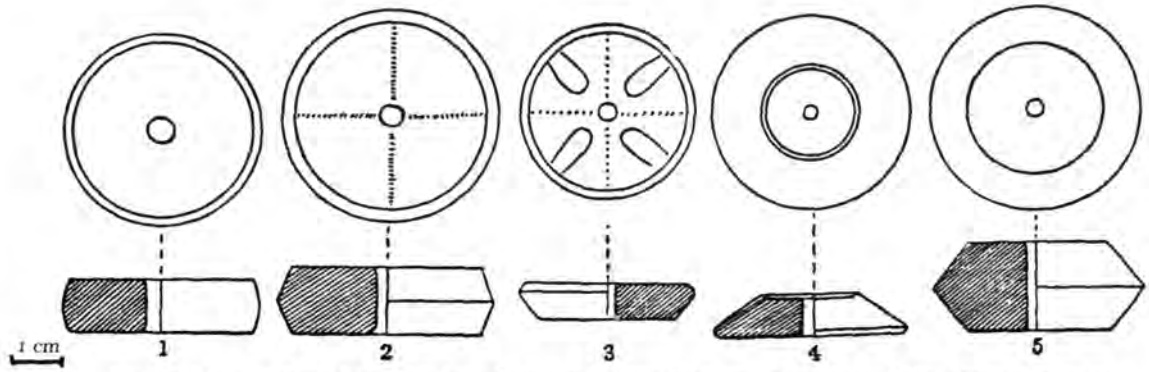


Fig. 86. Pottery whorls from Shih-hsia, Shih-hsia culture, Kuangtung province. Anon. (*517*), p. 4, p. 5, fig. 6: 1 (M10: 35); 2 (M27: 1); 3 (M29: 28); 4 (M29: 31); 5 (M102: 6).

Hupei province.[8.] Five whorls, made of pottery, were found at the site of I-chia-shan[1], Chhi-chhun[2] in Hupei,[b] while at the Li-chou[3] site in Hsi-chhang[4] county, the cultural relics bear affinities to those unearthed at the Ta-tun-tzu[5] site at Yiian-mou[6] in Yunnan province, and dated — 1260, where two polished, round, flat stone whorls measuring 2.5 cm in diameter were unearthed.[0] Trial diggings at

[a] **Kao Ying-Chhin (1), p. 50, fig. 3; p. 49.** **i> Anon.** *{68s),* **p. 32, pi. 5: 7 + 8.**
[c] **Anon.** *{745),* p. **448, p.** 447, fig. 7: **i$_4$(BT2: 7).**

[1] 易家山 [2] 圻春 [3] 禮州 [4] 西昌 [5] 大墩子
[6] 元謀

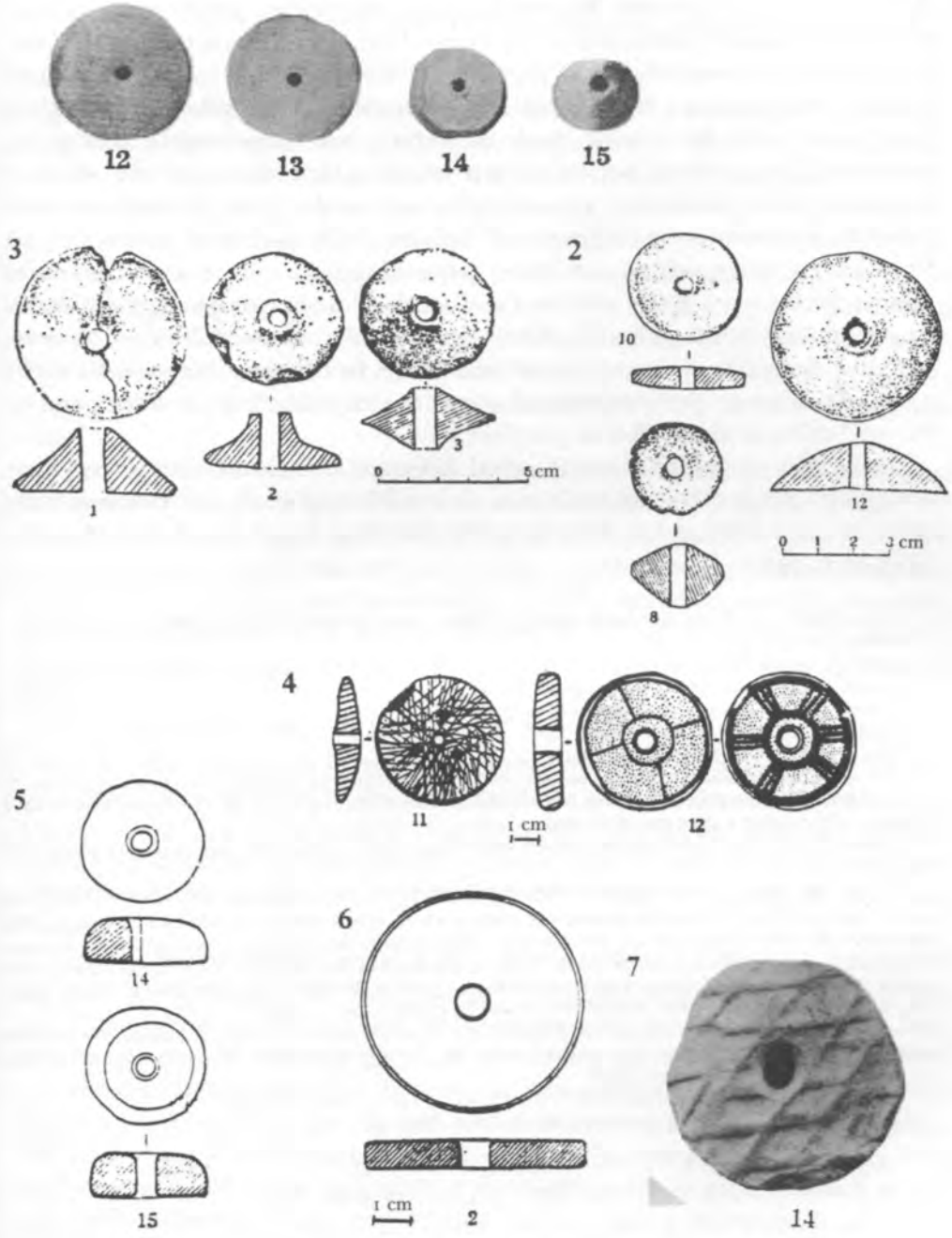


Fig. 87. Spindle-whorls from outside China proper. 1, Kirin; Anon. (*761*), p. 66, fig. 6: 12–15 (no scale); 2, Heilungchiang; Anon. (*652*), p. 314, fig. 6: 8 (T3 ③ : 3); 10 (H1 : 129); 12 (T5 ② : 1); 3, Heilungchiang; Anon. (*653*), p. 485, fig. 8: 1 (F3: 2); 2 (T6: 3); 3 (F4: 3); 4, Chhing-hai; Anon. (*632*), p. 366, fig. 1: 11 (91: 12); 12 (88: 33); 5 Tibet; Anon. (*672*), p. 137, fig. 1: 14, 15; 6, Inner Mongolia; Anon. (*720*), p. 524, fig. 4: 2. 7, Inner Mongolia; Anon. (*721*), pl. 1: 14.

the site of Shui-kuan-yin[1], Hsin-fan[2] county, Szechwan, produced 11 pottery whorls which may be divided into three types.[8.] Among them are three of the bead type, three of the truncated cone type and three of the round cone-shaped type.[b] A find of spindle-whorls is also reported from the site of Chung-ho[3], Wei-ning[4], in Kueichou,[0] and a few whorls, made of pottery, were excavated in Kuangtung province.[4] Fine polished pottery objects among which was a pottery whorl of trapezium shape measuring 3.1 cm in diameter and 0.7 cm in thickness, were found in the lower layer of the site of Shih-hsia,[5] Chhü-chiang[6] county.[e] Apart from this, 93 pottery whorls were found in the third phase excavation.' They are of various, well-known types, such as the disc, the double trapezium, the inverted trapezium and others (Fig. 86). Their decoration is very simple, very often resembling the Chinese characters *mi*[1] and *shih*[8].[e] In diameter they are all above 3 cm, the average perhaps around 4 cm. Spindle-whorls were also found at Ssu-wa[9] cultural sites in Kansu province.[11]

Outside the geographical regions which belonged to ancient China proper, there are reports of spindle-whorl finds from sites in Kirin (Fig. 87.1),[1] Heilungchiang (Fig. 87.2, 3)[j] Chhing-hai (Fig. 87.4)/ Tibet (Fig. 87.5)[1 a n]d Inner Mongolia (Fig. 87.6, 7).-

[a] Anon. *(746),* p. 406: the site shows remains of Shang cultural influence, see Chang (i), p. 266.
[b] Anon. *{746),* p. 406.
[c] Anon. *{707),* p. 61, fig. 3.
<• Anon. *{705),* p. 112. Mo Chih (/), p. 10, fig. 2: 21.
[e] Anon. *{511),* p. 2, fig. 2: 7; Chang (i), p. 512.
[I] *Ibid.,* pp. 4, 5, fig. 6: 1-5.
[8] *Ibid.,* p. 5, fig. 6: 2(M27: 1), 3(M2<): 28).
[II] For more details about the Ssu-wa culture, see Chang (1), pp. 405-7; Cheng (16), p. 26. Hsia Nai (7), p. 133, fig. 6; pi. 9; stone spindle-whorls are mentioned. Anon. *(696),* p. 66, pi. 5; the whorl pictured has a diameter of 7 cm and a thickness of 1.5 cm.
[1] Anon. *{617),* p. 50; twenty pottery whorls were found. Anon. *{761),* p. 66, fig. 12-15; 12 pieces were found.
1 Anon. *{654),* [n]g- [2: 1 2 – I] 4 ; [t e n] pieces were excavated. Anon. *{652),* p. 317, p. 314, fig. 6: 8(T3 (3) : 3), 10(Hi : 29), i2(T5 2:1). The site yielded ten pottery whorls which can be divided into three types: the bead type, the convex type, and the flat disc-type. They measure between 2.6 cm and 4.8 cm in diameter and are of greyish dark brown colour. Anon. *{653),* P- 4¾ [n]g- 8: 1 (F3: 2), 2(T6: 3), 3^4: 3). The spindle-whorls found are made of pottery and are more than 4.5 cm in diameter. They are already known types. The whorls belong to the lower layer which should be dated before — 1240.
[k] Anon. *{632),* p. 366, fig. 1: 11 + 12. The site may be dated around —1890; it yielded one hundred pottery whorls, small and fine in structure and of the flat disc-type. They all exhibit patterns, either impressed, incised or colourfully painted.
[l] Anon. *{672),* p. 136 (one stone whorl), p. 137, fig. 1, 14, 15 (stone whorls).
[m] Anon. *{720),* p. 524, fig. 4: 2 (stone whorl). Anon. *{721),* pi. 1: 14.

[1] 水觀音 [2] 新凡 [3] 中河 [4] 威宁 [5] 石峡
[6] 曲江 [7] 米 [8] 十 [9] 寺窪

(5) MAPS OF DISTRIBUTION OF NEOLITHIC SPINDLE-WHORL SITES

Explanation to Maps I-III

The reader is asked to regard these maps as an attempt to systematise in a roughly simplified chronological order the many neolithic sites which yielded spindle-whorls. The text about the particular site should be consulted for further details on the whorls of the places marked on the maps.

The maps contain no double entries. For example the site of Ta-tun-tzu, Phi-hsien, Kiangsu province (Map I: no. 2) produced spindle-whorls in all layers, in the Chhing-lien-kang layer and the layers of the Hua-thing and the Liu-lin culture which followed it. Because the Chhing-lien-kang layer was the earliest from which spindle-whorls were excavated there, it is the site entered on Map I; it is not, therefore, on Map II, which shows the Hua-thing and Liu-lin cultural sites.

There are two reasons which justify such a procedure. Firstly, a technology of this simple type, when once known in a region, was not lost but transmitted through subsequent ages; as a result all areas in which spindle-whorls were used at a comparatively early time carried on working with these implements. Secondly, easy legibility demands that names of sites already marked be omitted; however, the sites on Map II which include the sites of Map I are marked A, and on Map III which include those on Map I are marked A, and those of Map II by •.

The lungshanoid sites can be found on Map II. As explained in the text, the dating of these sites ranges from about — 3200 to — 1800, transitions from one date to another merging together. In a few cases the sites can be considered as contemporary with the Shang and even the Chou dynasty, but this observation does not count very much in the context of the neolithic period, and can be neglected here because it is the earliest dating of the spindle-whorl sites on which this study focuses.

As far as the sites of the —2nd and — ist millennia are concerned, Map III is far from being complete for two reasons. Firstly, neolithic remains of the Shang and Chou period could have been included in greater numbers, but this has been avoided because of the emphasis on the pre-Shang period; Shang spindle-whorls are discussed below. Secondly, because the vast amount of unpublished material preserved in Chinese provincial and county museums has not been examined, it has been decided to concentrate on those neolithic sites of the —2nd and — ist millennia which have not been marked previously on the Maps, and which are not regarded as classical Shang sites. For our purpose such a distinction is adequate.

From the map of the distribution of neolithic spindle-whorl sites dated as belonging to the — 5th and — 4th millennia, it is readily noticeable that all are situated in river valleys and lowland regions,[8] and especially in the Wei[1] River

» Kuo Mo-Jo *(13),* vol. 1, pp. 3-4.

¹ 渭



CHEKIANG
1 Ho-mu-tu , Yü-yao-hsien

KIANGSU
2 Ta-tun-tzu , Phi-hsien
3 Sung-tse, Chhing-phu-hsien

SHENSI
4 Pan-pho-tshun , Sian
5 *Pao-chi* , Pao-chi
6 Pei-pao-chai, Wang-chhü
7 Teng-chia-chuang, Lin-thung

SHANSI
8 Hsi-wang-tshun , Jui-chheng

HONAN
9 Miao-ti-kou, Shan-hsien
10 San-li-chhiao, Shan-hsien
11 Chhi-li-phu, Shan-hsien
12 Ta-ho-tshun, Cheng-chou
13 Hsi-ho-an-tshun , Mien-chhih
14 *Phei-li-kang*, Hsin-cheng
15 Cheng-chou, Cheng-chou
16 San-li-tien, Hsin-yang

ANHUI
17 Hsüeh-chia-kang, Chhien-shan

SHANTUNG
18 Tzu-ching-shan , *Pheng-lai*

LIAONING
19 Hsiao-chu-shan, Kuang-lu-tao, Chhang-hai
20 Shang-ma-shih, Ta-chhang-shan-tao, Chhang-hai

Map I.
Neolithic Spindle-whorl sites, c. −5000 to −3000.



CHEKIANG
1 Chhien-shan-yang, Wu-hsing
2 Shui-thien-pan, Hang-chou

KIANGSU
3 Hua-thing-tshun, Hsin-i
4 Liu-lin, Phi-hsien
5 Ssu-tun, Wu-chin

SHENSI
6 Pei-lin, Wei-nan

HONAN
7 Chien River Valley, Lo-yang
8 Ku-shui-ho, Yü-hsien
9 Tsao-lü-thai, Shang-chhiu
10 Wang-yu-fang, Yung-chheng
11 Hsia-wang-kang, Hsi-chhuan
12 Thang-chhüan-kou, Yen-shih

SHANSI
13 Kan-chün, I-chheng-hsien

HOPEI
14 Chang-chia-khou, Chang-chia-khou
15 Ta-chheng-shan, Thang-shan

SHANTUNG
16 Yin-chia-chheng, Ssu-chui
17 Liang-chheng-chen, Jih-chhao
18 Ta-wen-khou, Thai-an-hsien
19 Hsi-hsia-hou, Chhü-fu
20 Yeh-tien, Tsou-hsien

LIAONING
21 Kao-thai-shan, Hsin-min-hsien
Yao-kao-thai-shan, Hsin-min-hsien

HUPEI
22 Chhü-chia-ling, Ching-shan
Shih-lung-kuo-chiang, Ching-shan
23 Shih-chia-ho, Thien-men, Ching-shan
24 Kuan-miao-shan, Chih-chiang

HUNAN
25 Thang-chia-kang, An-hsiang
26 Meng-hsi, Li-hsien

KIANGSI
27 Ying-phan-li, Chhing-chiang

FUKIEN
28 Chien-ou, Chien-ou
29 Chien-yang, Chien-yang
30 Tung-chang, Fu-chhing
31 Than-shih-shan, Min-hou-hsien
32 Shih-tzu-shan, Feng-chou
33 Wu-phing sites, Wu-phing
34 Ho-thien-chhu, Chhang-thing
35 Keng-chao, Tung-shan-hsien

KUANGTUNG
36 Shih-hsia, Ma-pa

SZECHWAN
37 Ta-hsi, Wu-shan

KANSU
38 Ma-chia-wan, Yung-ching-hsien
39 Chang-chia-tsui, Yung-ching-hsien
40 Chhi-chia-chhuan, Yung-ching-hsien
41 Ta-ho-chuang, Yung-ching-hsien
42 Huang-niang-niang-thai, Wu-wei-hsien
43 Ti-pa-phing, Kuang-ho

Map II.
Neolithic Spindle-whorl sites, c. −3200 to −1800.



KIANGSU
1 Kuang-fu-lin, Sung-chiang
2 San-li-tun, Hsin-i-hsien
3 Pei-yin-yang-ying, Nanking
4 So-chin-tshun, Nanking

SHANSI
5 Thai-yüan, Thai-yüan

HONAN
6 Pan-chhiao, Mi-yang
San-so-lou, Mi-yang
Ching-shu-fen, Mi-yang
7 Mao-tshao-ssu, Thang-ho-hsien
Chai-tzhu-kang, Thang-ho-hsien
8 Ho-wang, Hsing-yang

SHANTUNG
9 Thung-yü, An-chhiu
10 Chiao-tung Peninsula
11 Chhing-tao, Chhing-tao
12 Phing-tu, Phing-tu

HUPEI
13 Huang-shih-shih, Huang-shih-shih
14 I-chia-shan, Chhi-chhun

KUEICHOU
15 Chung-ho, Wei-ning

SZECHWAN
16 Shui-kuan-yin, Hsin-fan-hsien
17 Li-chou, Hsi-chhang-hsien

KANSU
18 Ta-tung, Wu-wei-hsien
19 Ssu-wa-shan, Lin-thao

Map III.
Neolithic Spindle-whorl sites, c. −2nd to −1st millennia.

valley and in the North China Plain (Pei-phing-yiian[1]). The earliest sites yielding textile implements are concentrated in Shensi and Honan province, though other centres may be seen in the north Chekiang/south Kiangsu region, and a few in the Shantung/Liaoning region.

For the —3rd millennium the use of spindle-whorls is attested by finds in many more regions, for example, in central Shantung, in central Hupei, north Hunan and in Kansu province. It is extremely difficult to determine whether the spindle-whorl technology spread from Shensi into Kansu and from Honan into Shantung and Hupei or whether it developed independently in central Hupei, Shantung and Kansu. Speculation on this point would be premature, but it is hoped that future excavations will throw some light on it. At the end of the — 3rd millennium, another centre of spindle-whorl sites appears on the scene: this is Fukien province. Comparing the designs on the surface of the whorls from Fukien with those excavated in Hupei province immediately raises the question whether there was a connection of some kind between the people of Fukien and those of Hupei, or whether it was by pure coincidence that people in both regions, which are fairly distant from each other, painted geometrical designs on whorls.

If the idea is accepted that the number of spindle-whorl sites excavated in various provinces reflects the degree of technological activity, then we can conclude that by the end of the neolithic period, the traditional centres of textile technology, such as Honan and Shantung/north Kiangsu, are well represented. But it should be noted that areas like south Kiangsu and north Chekiang gained importance in silk production[8,] very early on - in the — 3rd millennium - and that Hunan and Hupei province were producing outstanding silk fabrics[b] in the - ist millennium.

For these reasons it appears desirable to propose a new interpretation of which regions were important from the point of view of textile technology. It seems that Honan province now loses its attraction and the coastal provinces Chekiang, Kiangsu and Shantung gain significance. Shantung may even be considered as a sort of pivot, a province where the coastal areas on the one hand and the Shensi/ Honan region on the other hand are linked.

One fact is surprising: Szechwan province cannot after all be considered an early textile centre. The sites are too few and the earliest one is close to Hupei province.

When taking into account that the spindle-whorl was the only device to spin and to twist threads, even in the historical Shang period, it should be no surprise to learn that whorls must have been manufactured on a large scale to cover the demands both of the common people as well as the Shang nobility.

* Anon. *{757),* pp. 3-8, pi. 10; Hsio-Yen Shih (1), p. 306; Anon. *{644),* P- 255; Kuhn (7), pp. 61-2.
•> Hsiung Chhuan-Hsin (/), pp. 49-56; Kao Chih-Hsi (2), pp. 65-70. Anon *{683),* PP- [1]–8-

[1] 北平原

(6) SPINDLE-WHORLS OF SHANG, CHOU AND HAN TIMES

The number of sites of Shang, Chou and Han times which yielded spindle-whorls is considerably smaller than those of the neolithic period. Several reasons can be adduced for this.

First, the period from the beginning of the Shang to the end of the Han dynasty covers only some 1800 years, whereas Chinese neolithic sites which yield whorls range from the — 5th to the — ist millennium, a span of more than 4000 years. But to claim that the neolithic period lasted 4000 years is only justified when we include the many 'underdeveloped' areas of China in which a neolithic life was led at the same time as in the North China Plain, the more advanced Bronze Age Shang people had established their kingdom. The same is true for the Western Chou period which followed the Shang in north China. If then we take into account the length of time the Shang dynasty lasted and the geographical area in which the Shang ruled, one arrives at the result that spinning activity must have increased enormously in the second half of the — 2nd millennium compared with an equally long time interval in the neolithic. One cannot draw a final conclusion but may assume that this increase in spindle-whorl manufacture had to do with the demands of a more advanced and organised Bronze Age society.[a]

Secondly, in a neolithic society the hand-spindle must have been of some value to its members as is indicated by a whorl, made of jade or a stone resembling jade, which was found as a burial present for a woman in a Liang-chu tomb.[b] Perhaps, though, in Shang times the tombs of women were no longer provided with spindle-whorls as was the case in the neolithic,[0] the spindle-whorls being replaced by other presents regarded as more suitable and representative for the deceased.

Thirdly, an organised Bronze Age society would have used more efficient and economic technologies than a neolithic people would have done. In its workshops it would employ trained and specialised workers, while the manufacture of spindle-whorls in all sizes, weights and qualities would have presented no problem. Well-proportioned whorls became the rule. Nothing is known about the organisation of spinning work from neolithic times or even from Shang times but it is certain that in Shang times a controlled labour force existed working in workshops for the aristocracy.*[1] In such a way the spindle-whorl became a mere implement, and lost its significance as a personal object suitable to be buried with its female owner in a tomb.

Fourthly, in the sites of the Shang period which have been excavated, spindle-whorls are no longer important finds. Hence they are not always reported in the publications. Moreover, in mid-Chou times, about the — 5th century, the spindle-wheel was invented, and this reduced the importance of the spindle-whorl as a

*** The interesting possibility that the form of the spindle-whorl influenced that of the first round Chinese** bronze coins is referred to in Wang Liang-Zhou (i).

» **Anon.** ***(70g),*** **pi. 11: 6-8.**

[c] **Cheng (17), p. 110.**

[d] **Kuhn (8), pp. 399-401.**

means of large scale private textile production. By Han times the spindle-wheel must have been in use all over China proper because the number of spindle-whorls excavated decreased drastically.

There is no doubt that the Shang culture, with its various centres in Honan province, exerted an undoubted influence on other 'underdeveloped' areas in China, but at present it is premature to try to decide whether Shang expertise in the field of textile technology spread into Hunan, Szechwan and Kiangsi; it may be, perhaps, that it was other technical achievements which were taken over by the local peoples.*

During neolithic times the spindle-whorl was a technical device valued as a cultural object, a fact which is indicated by the variety of shapes and patterns, but in Shang and Chou times it became no more than a technical instrument, which meant that it very seldom displayed its maker's imagination or predilections. Shang and Chou whorls do not mirror a cultural attachment either; most of their shapes come from the neolithic repertoire of whorls without adding any new features; in this way they escape definition. From the many typical Shang period cultural sites the greatest number and the best relics are to be found in Honan province, followed by Shensi and Hopei, although there are sites in Kiangsu province which held examples contemporary with the Shang, and influenced by the Shang culture.

From the excavation in autumn 1952 at Erh-li-kang[1] in Cheng-chou[2] the discovery of 20 complete and 23 fragmentary pottery spindle-whorls is reported,[b] while fourteen pottery whorls were found outside the south gate of Cheng-chou (Fig. 88);[c] 25 pieces were also found at the site of Kho-la-wang-tshun[3], Cheng-chou;[d] in addition other whorls made in Cheng-chou have been found.[6] Thirteen spindle-whorls were produced from the Shang site of Chhi-li-phu[4] in Shan county/ and 30 grey pottery ones were found at the Chien[5] River site in Meng county.[8] The An-yang site of Ta-ssu-khung-tshun[6] yielded 8 spindle-whorls during the excavation of 1953,[11] and the site of Hsiao-thun[7], near An-yang, produced 6 pottery whorls in the excavation of 1955.[1] The results of archaeological work at Hou-chia-chuang[8] near An-yang have also been published in full, and tomb no. 1217 proves to be of the utmost interest in our study (Fig. 89; Fig. go).[1] Seventeen pottery whorls in brownish, brick-red and grey colours, are systematically described in a

» Chang (1), pp. 266-7.
[b] An Chih-Min (5), p. 83, p. 102, fig. 9: 1 and 2.
[c] Anon. *{612),* p. 74, fig. 10; pi. 5: 19-22.
[d] Anon. *{610),* p. 59, fig. 14: 1, 2, 3; pi. 8: 21. Thanks are due to Hsai Nai for providing information about the local pronunciation of the village name.
[e] Anon. *{613),* pi. 5: ii; Tsou Heng *{1),* p. 82, fig. 3: 11.
» Anon. *{663),* P- 35, [fi]g- '«: 5! P- 45-
« Anon. *{660),* p. 37, fig. 4: 8. » Ma Te-Chih *{1),* p. 46.
[1] Anon. *{693),* p. 69, fig. 5; pi. 3: 5. ' Liang Ssu-Yung *{2),* pp. 124-6.

[1] 二里岡 [2] 鄭州 [3] 旭旮王村 [4] 七里鋪 [5] 澗
[6] 大司空村 [7] 小屯 [8] 侯家莊

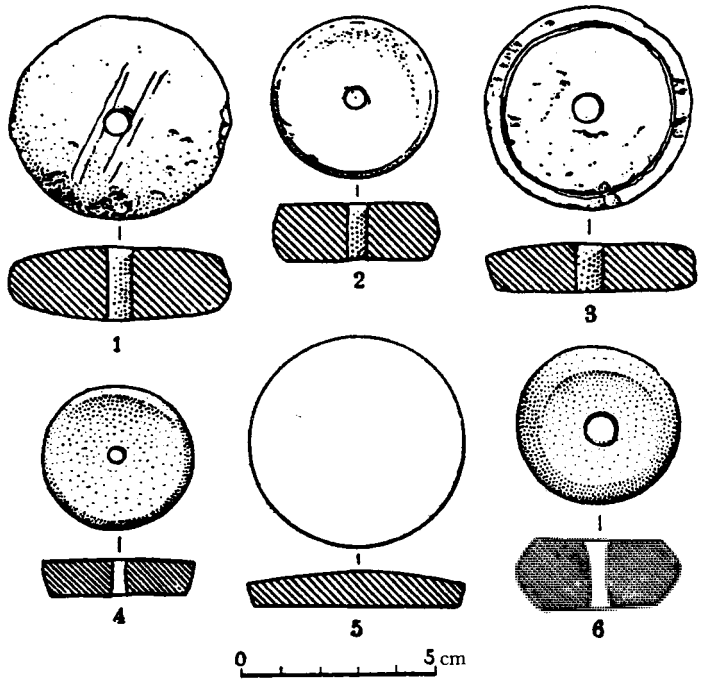


Fig. 88. Pottery whorls from Cheng-chou, Shang dynasty. Anon. (*612*), p. 74, fig. 10: 1 (T84: 34); 2 (T94: 58); 3 (T85: 34); 4 (T94: 60); 5 (T85: 56, unfinished whorl); 6 (T95: 24).

table[a] and pictured in plates? The biggest has a diameter of 5.6 cm,° the smallest of 2.95 cm" only, while 12 range below 5 cm, 6 being even smaller than 4 cm. Their thickness varies between 1.2 and 2.5 cm, 9 of them being below 2 cm, and their weights range between 30.7 g and 100.3 §• One whorl only displays a design of 'snakes' on its bottom surface (Fig. 90.6), and is the only zoomorphic design so far discovered.

Four pottery whorls were found at the site of Thai-hsi-tshun ' in Kao-chheng[2], Hopei province (Fig. 91). Round bead type whorls were discovered, one measuring 3 cm in diameter, 2.8 cm in height and weighing 25 g, while another has a diameter of 4.6 cm, a height of 2.3 cm and weighs 45 g. There were also two whorls weighing 50 g each, one a flat disc of 5 cm in diameter, the other hexagonal like a star *(liu-chiao-hsing[3])*.[e]

From the site of Nan-ta-kuo-tshun[4] in Hsing-thai[5], Hopei province one spindle-whorl is reported;' in Hua county, Shensi province one whorl was also found,[g]

* ***Ibid.*, p. 125.**
[6] ***Ibid.*, pis. IC: 7-12; C: 1-10; CII: I-IO; CIII: 1-5.**
[0] ***Ibid.*, p. 125: 15.** <• ***Ibid.*, p. 125: 4.**
* **Kao Han-Yü (/), p. 45 (M30: 1), (T_4: i), (T13: 16), (T13: 59).**
' **Thang Yün-Ming (/), p. 61, fig. 6.** [g] **Hsii I (/), p. 65.**

[1] 台西村 [2] 藁城 [3] 六角形 [4] 南大郭村 [5] 邢台

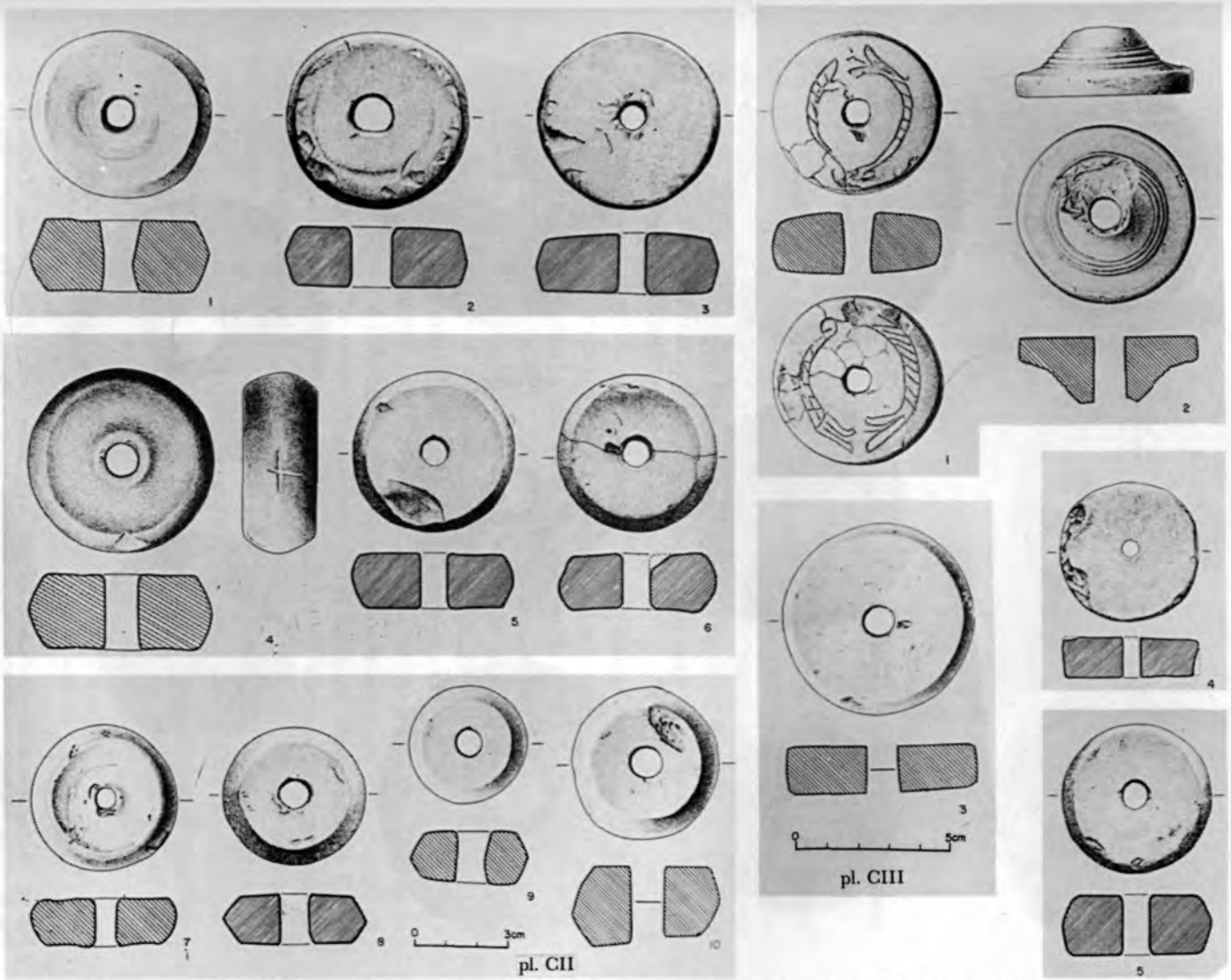


Fig. 89. Pottery whorls from HPKM 1217, Shang dynasty. Liang Ssu-Yung (*2*), p. 125, pl. CII: 1 (R16161/4: 97); 2 (R16090: 2/4: 2295); 3 (R16090: 3/4: 660); 4 (R16090/4: 2298); 5 (R16092: 1/4: 92); 6 (16092: 2/4: 1634); 7 (R16162/4: 86); 8 (R16095/4: 660); 9 (R16096: 1/4: 574); 10 (R16096: 2/4: 1690). Liang Ssu-Yung (*2*), p. 125, pl. CIII: 1 (R16088/4: 652); 2 (no number given); 3 (R16091: 1/4: 1690); 4 (R16091: 2/4: 660); 5 (R16090: 4/4: 2375).

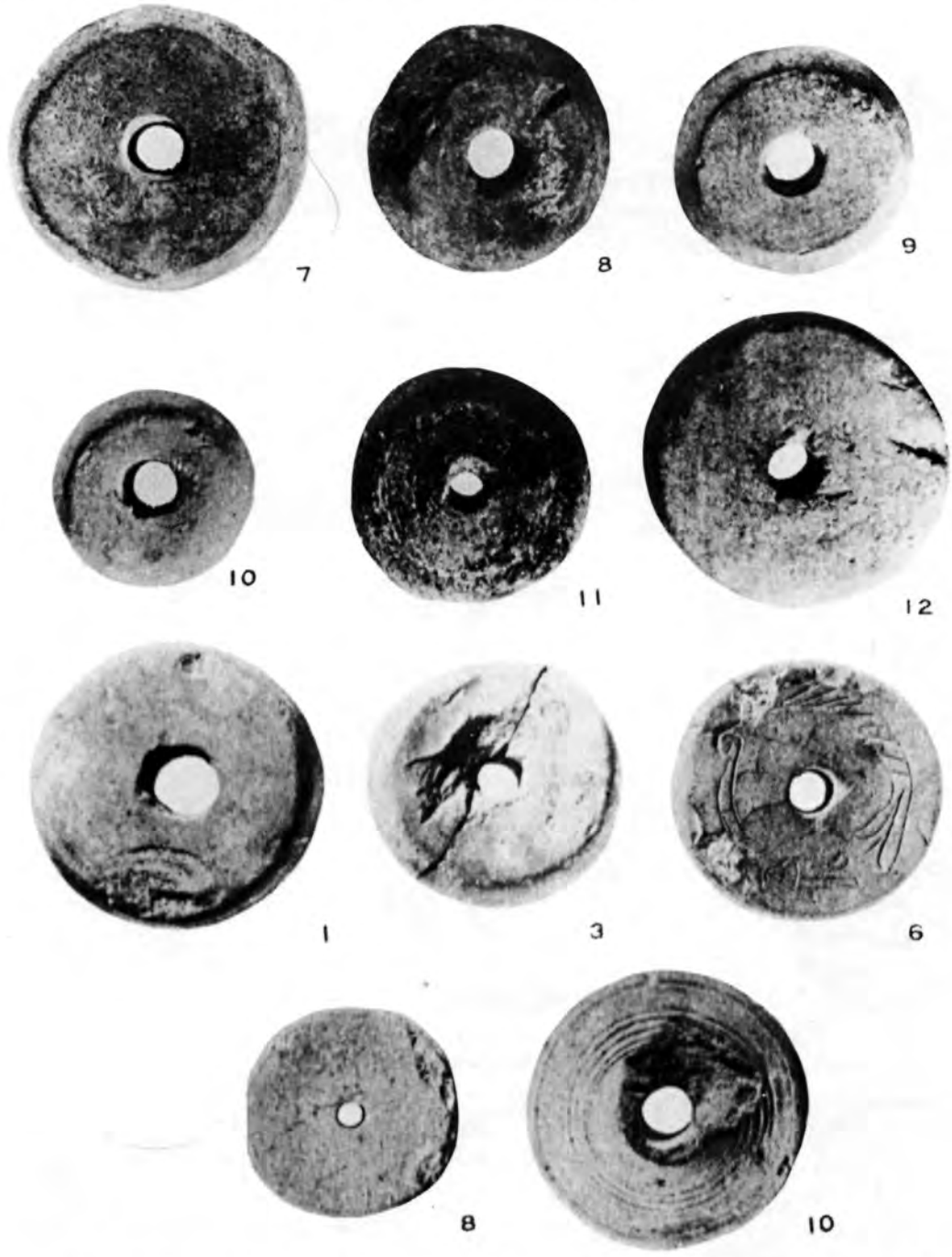


Fig. 90. Photographs of the whorls from HPKM 1217, Shang dynasty. (The drawings of them are in Fig. 89.) Liang Ssu-Yung (*2*), pl. IC: 7 (Fig. 89.1); 8 (Fig. 89.10); 9 (Fig. 89.8); 10 (Fig. 89.9); 11 (Fig. 89.7); 12 (Fig. 89.3). ($\frac{1}{3}$ of original size.) Liang Ssu-Yung (*2*), pl. C: 1 (Fig. 89.2); 3 (Fig. 89.6); 6 (Fig. 89.1 (CIII)); 8 (Fig. 89.4); 10 (Fig. 89.2 (CIII)). (Original size.)

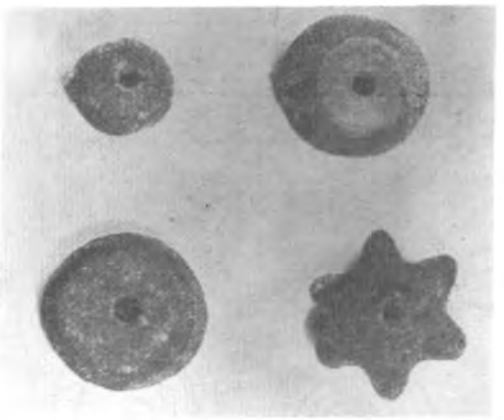


Fig. 91. Spindle-whorls from Thai-hsi-tshun, Shang dynasty. Kao Han-Yü (*1*), p. 45, fig. 4 (no scale).

but in the Shang layer of Hstieh-chia-kang' in Chhien-shan county a number of spindle-whorls were excavated.[a] Thirteen pieces of grey pottery were found at the Ma-chhiao[2] site in Shanghai,[b] and several whorls are mentioned in publications about Kao-huang-miao[3], in Hsü-chou, Kiangsu Province[0] and from Hu-Shu[4] cultural sites contemporary with the Shang.[d] The site of Thai-kang ssu[5] in Nanking yielded 11 spindle-whorls.[6]

The Feng River valley where the Western Chou capitals of Feng[6] and Hao[7] were situated was an area of archaeological interest for a long time in the 1950s.* Apart from the Kho-hsing-chuang« excavation carried out in 1955, the site of Chang-chia-pho[9] excavated in 1956—57 attracted attention, and is important here. It contained remains of houses dated as belonging to two different stages, and also had a large number of tombs. Chinese archaeologists expressed the opinion that the remains were probably left by the ordinary working people of the time.[8] Certainly the whorls discovered (Fig. 92) belonged to people working and living in a rural environment, not concentrated in workshops or other units with controlled working conditions. The whorls themselves, dated as being from Western Chou times, are made in the neolithic tradition, displaying various patterns such as incised tooth-bands or kinds of circles and dotted lines like the Chinese character *mi*[10] within a dotted circle (Fig. 92.2). A total of 233 were found, and are rather big compared with the Shang whorls discovered at Hou-chia-chuang. One bone spindle-whorl is also preserved, while another has four characters carved on the surface (Fig. 93). No less than 167 belong to the flat disc-type, and 54 are of the

[a] **Anon.** *{628),* **p. 319.**
[0] **Anon. (679), p. 11.**
[e] **Anon.** ***{718),*** **p. 121, fig. 9: 1-8.**
« ***Ibid.,*** **p. 193.**
[b] **Anon.** *{725),* **p. 125.**
<i **Anon.** *{623),* **P- «*7-**
1 **Anon.** *{645).*

薛家崗 馬橋 高皇廟 湖熟 太崗寺
澧 鎬 客省庄 張家坡 米

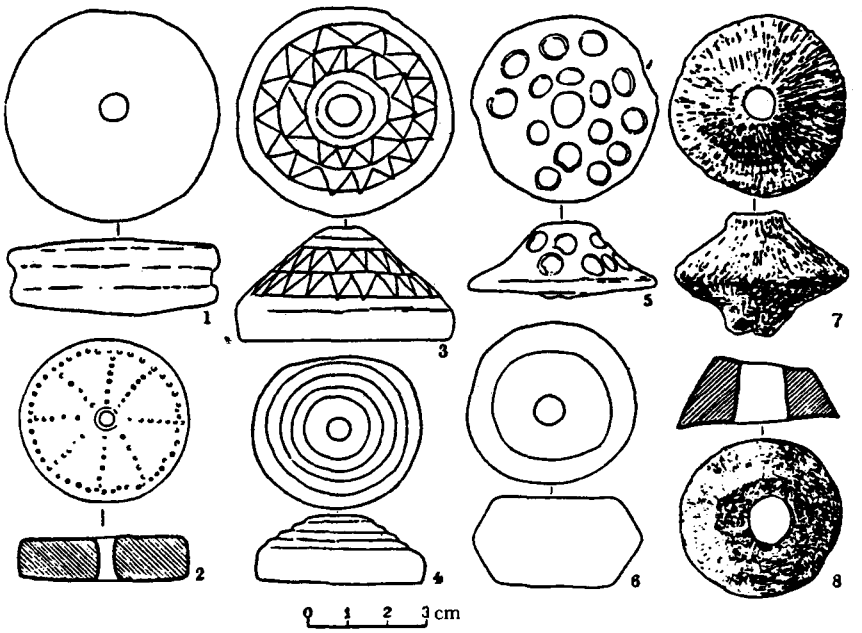


Fig. 92. Pottery and bone spindle-whorls from Chang-chia-pho, Western Chou dynasty. Anon. (*645*), p. 89, fig. 57: 1 (T110: 4); 2 (T412: 4: 8); 3 (T107: 4: 28); 4 (T124: 4: 14); 5 (T105: 4: 12); 6 (T126: 3); 7 (T122: 3: 3); 8 (T313: 3: 23).

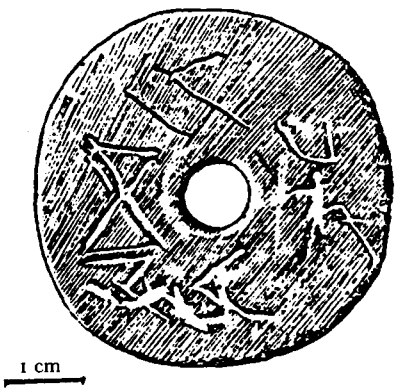


Fig. 93. Pottery spindle-whorl with four characters from Chang-chia-pho, Western Chou dynasty. Anon. (*645*), p. 89, fig. 58 (T105: 4: 12, original size).

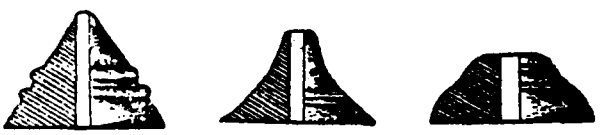


Fig. 94. Pottery whorls from Chhing-yang-kung, Chheng-tu, Warring States period. Anon. (*615*), p. 413, fig. 4 (no scale).

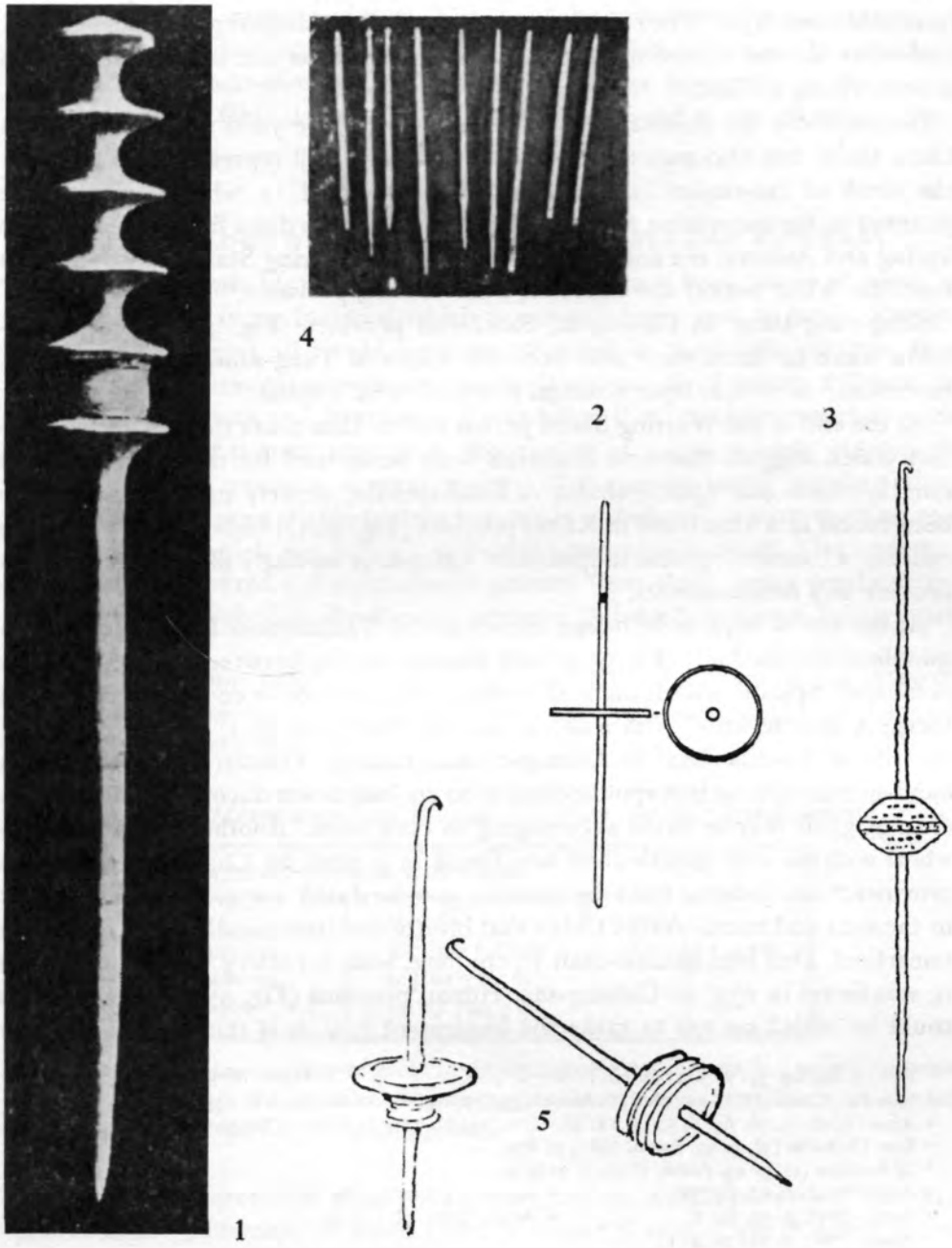


Fig. 95. Spindle-shafts of wood, bronze and iron, Han dynasty. 1, Kansu; made of wood; Anon. (*698*), pl. 4: 11. 2, Yünnan; made of bronze; Anon. (*762*), p. 126. pl. II: 4. 3, Kueichou; made of iron; Anon. (*706*), p. 210, fig. 4: 7. 4, Sinkiang; made of wood; Anon. (*677*), pl. I: 10–11. 5, Hunan; made of iron and bronze; Anon. (*644*), p. 52.

truncated cone type.[a] The ornaments and some of the shapes[1]» give evidence of a preference for the Shensi neolithic tradition which was still in existence in this area in Western Chou.

Not only did the classical regions of Chinese culture yield spindle-whorls[0] in Chou times, but also regions which have not been well represented so far. The cist tomb of Hsi-thuan[1] in Kirin province produced 12 whorls, which were pictured in the excavation report of the site.[d] The tomb dates from the end of the Spring and Autumn era and the beginning of the Warring States period. Whorls from the latter period are reported from Hunan province,[e] from the tomb of Chhing-yang-kung[2] in Chheng-tu, Szechwan province (Fig. 94),[1] from a boat-coffin tomb in Szechwan,[6] and from the tombs of Tung-sun-pa[3] in Pa county, Szechwan,[h] as well as from Kuangsi province[1] and Yunnan.[j]

At the end of the Warring States period and in Han times there is documentation which suggests that new materials were being used for the manufacture of spindle-whorls and spindle-shafts. A hand-spindle, entirely made of wood, has been found in a Han tomb in Kansu province (Fig. 95.1) ; Chinese[k] archaeologists called it a ' wooden spindle to spin yarn ' *(fang-hsien mu-ting*)* though they did not provide any measurements.

At the site of Niya in Min-feng county in the Taklamakan Desert, 10 wooden spindle-shafts *(mu-kan*)* (Fig. 95.4) with lengths varying between 17 to 25 cm were excavated. Spindle-whorls made of wood, pottery and bone could be attached to these.[1] A spindle-whorl with a bronze spindle-shaft (Fig. 95.2) was discovered at the site of Li-chia-shan[6] in Chiang-chhuan county, Yunnan province,"[1] and a hand-spindle with an iron spindle-shaft of 20 cm length was discovered in Kueichou (Fig. 95.3). It may be dated as belonging to Han times.[n] Another pottery spindle-whorl with an iron spindle-shaft was found in a tomb in Chao-hua, Szechwan province," and judging from the remains, may be dated + 274. But it was not only in the west and south-west of China that bronze and iron spindle-shafts have been unearthed. One iron spindle-shaft 19 cm long, with a pottery whorl attached to it, was found in 1957 in Chhang-sha, Hunan province (Fig. 95.5) .[p] Bronze rings could be added on top to make the implement heavier if this was required for

» *Ibid.*, p. 89, fig. 57: 2, 3, 5; pi. LXII: 2 + 3. " *Md.*, pp. 88-9.
[c] Kuo Pao-Chün (j), p. 20; pi. 6: 6. Anon. *{759)*, pp. 47-8. Anon. *(634)*, p. 145.
a Anon. *{618)*, p. 38, fig. 6, 9, 11, 12; pi. 1: 12, 13; pi. 2: 3-5; pi. 4: 3; pi. 5: 7, 8, 10, 11; pi. 7:6-7.
[e] Kao Chih-Hsi *{3)*, p. 33. Anon. *{681)*, p. 659.
' Li Fu-Hua *{1)*, p. 45. Anon. *{615)*, p. 413, fig. 4.
« Anon. *{744)*, p. 73, fig. 72. h Anon. *{747)*, p. 29, fig. 20.
1 Anon. *{703)*, p. 30, fig. 8. J Anon. *{763)*, pi. 1:6-7.
[k] Anon. *{698)*, p. 24; pi. 4: 11.
[1] Anon. (677), p. 120, pi. I: 10-11. In the same area another wooden whorl was found. Anon. (676), p. 10, fig. 4.
[m] Anon. *{762)*, p. 127, p. 126, fig. 31: 4; pi. 11: 4.
[n] Anon. (706"), p. 209, p. 210, fig. 4: 7.
[0] Chang Yen-Huang, Kung Thing-Wan (/), p. 29. » Anon. *{644)*, p. 52.

[1] 西團 [2] 青羊宮 [3] 冬笋壩 [4] 紡綫木錠 [5] 木桿
[6] 李家山

spinning different qualities of yarn. The tip of the spindle-shaft was in the shape of a hook to which a loop of the material to be processed could be attached. Another iron spindle-shaft, partly damaged, dated as belonging to the end of the middle of the Chin dynasty *(c.* +347) has been found at the Miao-hou-shan[1] site in Fukien.[a]

(7) TYPOLOGY OF SPINDLE-WHORLS: SHAPES AND PATTERNS

Most spindle-whorls of the neolithic period may have been made of wood, a suitable, strong, lasting material which is comparatively easy to work. Regrettably though, almost all would have disintegrated in the course of time, thus leaving us with the impression that most whorls were made of pottery, followed by stone in second place and then bone. Nevertheless it is certainly true that when the technology of pottery improved, the quality of spindle-whorls did too. It became easier to produce a great variety of shapes in larger numbers than previously, when poor friable pottery had made it desirable to turn to stone and bone, materials which are difficult and time-consuming to work. The improvements led to low-fired red earthenware pottery *(hung-thao[1])* being partly abandoned in favour of the high-fired grey stoneware *(hui-thao[3])* and dark-brown ware *(ho-thao*).**

It may be of some help to provide a few general figures based on our research to give an impression of the range of measurements and weights of Chinese neolithic spindle-whorls :

Table 2. *Measurements and Weights of Chinese Neolithic Spindle-whorls*

Diameter, thickness and weight		
	whorls	holes
diameter	2.6 to 11.2 cm	0.35 to 1.3 cm
thickness	0.4 to 3.2 cm	
weight	12 to 100.3 g*	

* In most cases no weights are given in the archaeological reports, but we may assume that big whorls from the neolithic are as heavy as Shang whorls from Hou-chia-chuang tomb no. 1217; Liang Ssu-Yung *(2),* p. 125.

The average diameter of whorls was about 5 cm, the weight some 35 g. The yarn produced had a diameter of about 1 mm or more;[0] that is, it was of rather coarse

[a] **Huang Han-Chieh *(1),* p. 383.**

[6] **Margaret Medley (3), pp. 279, 281 ; p. 13 *thao,* meaning pottery in general, is used in specific cases to indicate low-fired ware, or what we should call earthenware; *tzhu,* meaning high-fired ware, including both stoneware and porcelain. Anon. *{644),* PP- 5°-'-**

[c] **Anon. *{644),* P- 50.**

[1] 廟后山 [2] 紅陶 [3] 灰陶 [4] 褐陶

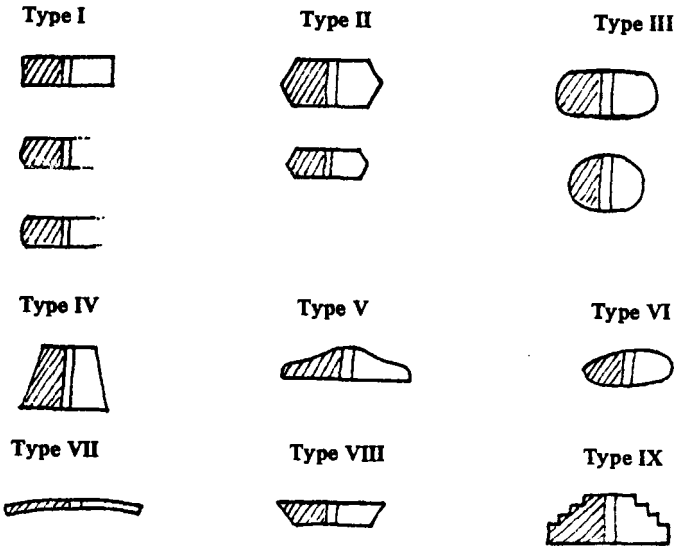


Fig. 96. Main types of spindle-whorls in China. Type I, the round flat disc-type (*pien-phing yüan hsing-shih*[1]); this type was made either with straight rim (*chih-pien*[2]), with angular-shaped rim (*chiao-hsing-pien*[3]) or with convex curved (bow-shaped) rim (*hu-pien*[4]). Type II, the double trapezium types (*thi-hsing-shih*[5]): the high-body double trapezium type (*kao-shen hsing-shih*[6]), the low-body double trapezium type (*ti-shen hsing-shih*[7]). Type III, the abacus bead type (*suan-chu hsing-shih*[8], *suan-phan-chu hsing-shih*[9]). Type IV, the truncated cone type (*tuan-mien-thi hsing-shih*[10]; *yüan-chui hsing-shih*[11]). Type V, the convex-shaped type (*tuan-mien thu-tzu hsing-shih*[12]). Type VI, the oval (wheel) type (*chhe-lun hsing-shih*[13]). Type VII, the round slice type (*yüan-phien hsing-shih*[14]). Type VIII, the inverted trapezium type (*hsiao-thien hsing-shih*[15]). Type IX, the step-shaped type (a truncated cone type, with a stepped surface) (*thi-chuang hsing-shih*[16]). Hsia Nai would prefer the term stepped trapezium type, *chieh-chi hsing-shih*.[17]

quality. Such yarns could have been used for weaving fabrics and also for manufacturing fishing-nets.

Basically, there are nine main types of spindle-whorls found in China. These are depicted in cross-section (Fig. 96) ; apart from these we have material evidence of whorl-types limited to specific regions. Unfortunately it is not possible to tell from its type to which millennium a particular whorl belongs because no chronological order of development is evident. It is therefore only possible to generalise.

The type most common in neolithic times and in the Shang dynasty was type I, the round flat disc, which seems to have acted as a kind of prototype. The largest diameter found was n.2cm,[a] the greatest thickness 3.2 cm, though another big whorl measured 8.4 cm in diameter and had a thickness of 1 cm.[b] The smallest diameter of this type was about 3 cm with a thickness of some

» Anon. *{628)*, p. 294, fig. 12: 6.

•> Anon. *{702)*, p. 198, fig. 8: 7.

[1] 扁平圓形式 [2] 直邊 [3] 角形邊 [4] 弧邊 [5] 梯形式
[6] 高身形式 [7] 低身形式 [8] 算珠形式 [9] 算盤珠形式 [10] 斷面梯形式
[11] 圓錐形式 [12] 斷面凸字形式 [13] 車輪形式 [14] 圓片形式 [15] 簫田形式
[16] 梯狀形式 [17] 階級形式

0.3 cm-0.4 cm.[a] The average size ranged between 5 cm to 6 cm and was about 1.5 cm thick; this means that such a whorl had a weight of approximately 30 g to 40 g, depending on the material of which it was made. Weights of 66 g were also to be found in this group.[b] Most whorls were excavated in the following provinces, arranged according to the significance of the examples discovered: Honan, Shensi, Chekiang, Kansu and Kiangsu. There are also specimens from Anhui, Hupei, Fukien, Shansi and Shantung.

Type II was the second most important type of spindle-whorl shape from the neolithic period to the Chou dynasty. The average diameter at the waist of the whorl was about 4 cm, its thickness between 1.2 cm to 2 cm. The provinces where type II was discovered are Honan, Kiangsu, Fukien, but also Kuangtung, Kiangsi, Hunan, Hupei, Hopei, Shensi and Szechwan.

Compared with types I and II, all others are of only minor importance; nevertheless they appear to be significant enough to give their distribution in China from the neolithic to the Chou:

type III: Honan, Shantung, Fukien, Kiangsi, Szechwan;
type IV: Shensi, Chekiang, Fukien, Kuangtung;
type V: Shensi, Chekiang;
type VI: Honan, Hupei, Kiangsi, Fukien;
type VII: Honan, Shantung, Hupei, Kansu, Liaoning;
type VIII: Honan, Kiangsu, Fukien, Kuangtung;
type IX: Shensi, Szechwan, Kiangsu.[0]

The range of spindle-whorls used in Shang times is limited to types I, II, III, IV, VIII; in Chou times to types I, II, III, and a type which represents a combination of IV and V. The average diameter of 5 cm to 6 cm in the neolithic, became smaller and in Shang times was about 4 to 5 cm. The reduction of diameter must have resulted in a finer better quality yarn, which led to an improvement of fabrics made of a particular raw material.

Apart from these common types, there are many regionally manufactured, differently shaped spindle-whorls which have to be treated separately from the 'normal' types. These never spread over the borders of the province where they were produced and used. Their temporary appearance was an expression of cultural creativity and independent craftsmanship. It is not known whether the creation of shapes or the shapes themselves had any meaning, or if the makers of the spindle-whorls only wanted to try out new shapes from the material they were using. The same is true for the many ways in which spindle-whorls were patterned, painted and shaped by impressions and incisions. The driving power behind the will to 'improve the appearance' of the whorl is unknown. It was nothing else but a

*** See various samples excavated in Hupei in Chhü-chia-ling cultural sites.**

» Anon. *{644)*, P- 225.

[c] The Kiangsu spindle-whorl of this type is extremely large with a diameter of more than 10 cm, see 'Kiangsu Phi-hsien', Anon. *[625)*, P- 25, fig. 19:2.

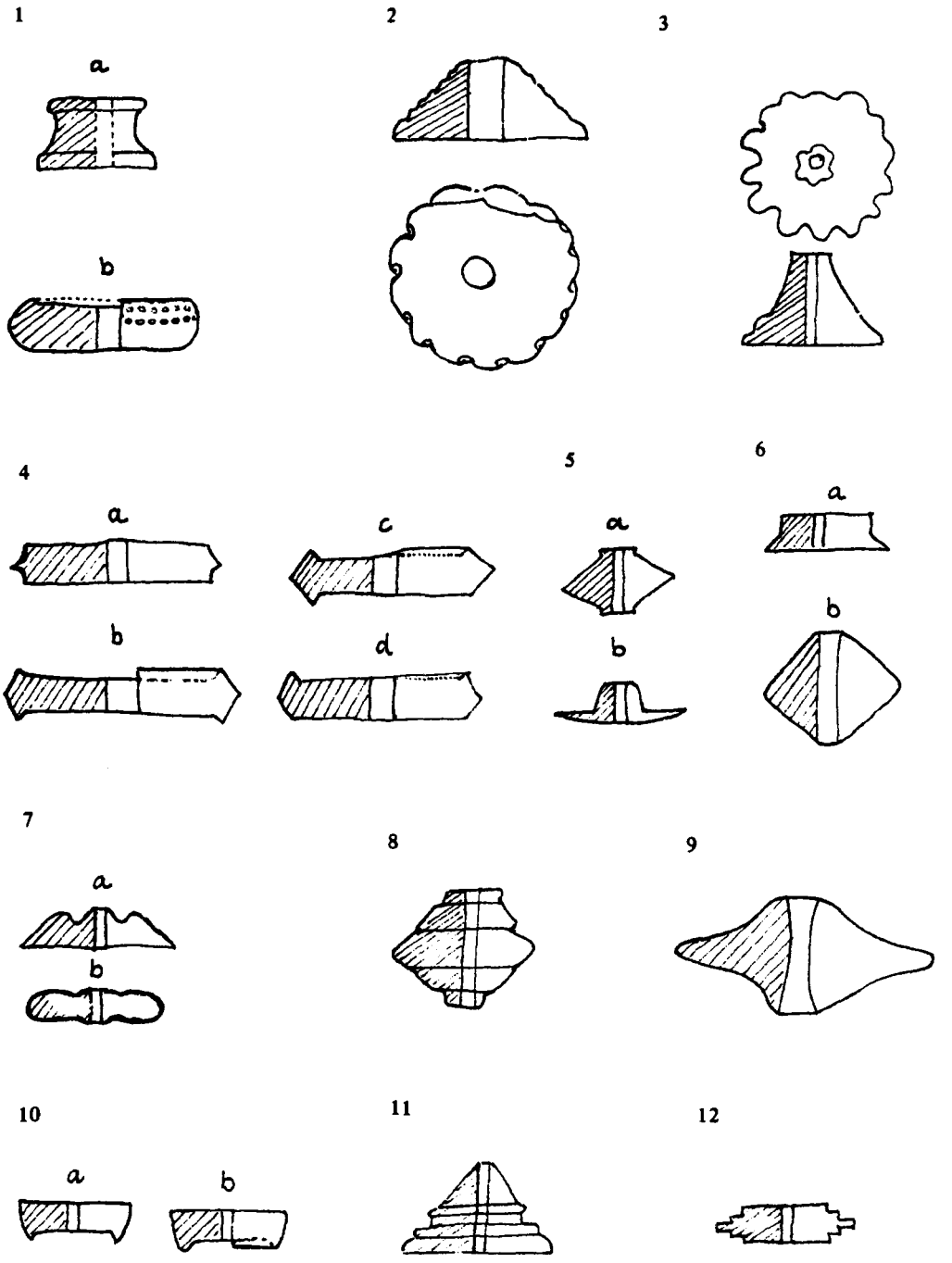


Fig. 97. Non-typical whorls. 1, Ho-mu-tu, Chekiang. 2, Pei-pao-chai, Shensi. 3, Teng-chia-chuang, Shensi. 4, Chhü-chia-ling, Hupei. 5, Ying-phan-li, Kiangsi. 6, Than-shih-shan, Fukien. 7, Chien-ou, Fukien. 8, Shih-tzu-shan, Fukien. 9, Chhi-chia-chhuan, Kansu. 10, Kao-thai-shan, Liaoning. 11, Chhing-yang-kung, Szechwan. 12, Shih-tshun, Shantung.

simple technical device. At this stage, however, the solutions to such problems of interpretation can be no more than guesswork, because a satisfactory answer would require taking into account much of the pottery remains from the various sites which have been excavated, and this lies far beyond the scope of this study.

The earliest, non-typical spindle-whorls belong to the Ho-mu-tu culture in Chekiang province and to the Yang-shao culture in Shensi province. One whorl of the truncated cone type with a narrow waist has been named *tuan-mien kung-tzu hsing-shih*[1] by Chinese archaeologists. In cross-section it is like the character *kung*[2] (Fig. 97.1), but the Shensi whorls are either shaped like a cog-wheel—they have a tooth-shaped rim (Fig. 97.3)—or display a fourteen-lobed shape (Fig. 97.2).

The site of Chhii-chia-ling yielded various strangely shaped whorls, most of them with painted patterns on the surface (Fig. 97.4). The Kiangsi site of Ying-phan-li produced sharp-edged ones which are without parallel in China (Fig. 97.5). Compared with the whorls excavated in Hupei and Kiangsi, the outlines of the Fukien whorls are soft and round; they do not display a prominent angular geometry (Fig. 97.6-8). Other whorls which do not fit in the traditional frame of whorl-shapes were found in Kansu (Fig. 97.9), Liaoning (Fig. 97.10), Szechwan (Fig. 97.11) and Shantung (Fig. 97.12).

Finally, it is worth remarking that while it is evident that many spindle-whorls have been discovered in China, and even a few spindle-shafts, no distaff has been unearthed. Yet this should cause no surprise because distaffs were for the most part made of wood, and this would have disintegrated with time. Moreover, distaffs differ very little, if at all, from plain wooden sticks, and so would be well nigh impossible to recognise.

[1] 斷面工字形式 [2] 工

(*d*) THE EVOLUTION OF THE SPINDLE-WHEEL

Having described and explained the spindle-whorl—the oldest efficient device for the production of yarn—illustrated the various types and analysed its distribution in China, the next stage is to discuss the spindle-wheel. This must be seen in the context of silk processing. Though the technical features of the spindle-wheel may have evolved from the spindle-whorl, a few introductory remarks are desirable to indicate its place in the development of technology and to help place it in a wider perspective. For a better understanding of mechanised spinning within the field of textile technology as a whole, a few words should also be added on the research already done and published in books and articles. The reader will notice that spinning was a rather neglected subject, and that in many cases conclusions were drawn too precipitously.

The publications arising from the famous expeditions to Asia during the first half of this century contain much relevant material on textiles, particularly on the structural analysis of weaving.[a] Western works on other aspects of textile technology are, with few exceptions,[b] seldom sufficiently specialised. Since 1945, however, the general situation in the field has improved; Japanese scholars have published several fundamental articles and books,[c] a primary source on traditional Chinese technology the *Thien Kung Khai Wu* (The Exploitation of the Works of Nature) of +1637 has been translated and annotated several times;[d] Western scholars have adopted new approaches, though still showing a bias towards the structural analysis of fabrics.[e] Most important of all, Chinese scholars have published their own attempts to reconstruct important aspects of Chinese textile technology.[f]

All these contributions—including, of course, this study—are still only pieces of a jigsaw. Nevertheless, it is possible to add an additional piece which turns out to be fundamental to a general understanding of Chinese yarn production.

[a] It is impossible to list more than a few references here; for additional entries see the volume in this series on weaving: Le Coq (1); Andrews (1), pp. 3–10, 71–7, 147–52, 215, 265, 326–7; Yetts (1), pp. 168–85; Stein (2), esp. vol. 1; Trever (1); Ashton (1), pp. 305–19; Sylwan (3); Sylwan (4); Lowry (1), pp. 67–71; Lowry (2), pp. 2–30; Riboud (2), pp. 252–80.

[b] The most remarkable works are: Rondot (4), pp. 332–50; Julien (12); Hedde (2); Bavier (1); *SILK*; Franke (11); Hommel (1); Montell (4), pp. 109–23; Shih Min-Hsiung (1), translated by Sun E-tu Zen (3).

[c] Ohta (*2*); Sasaki (*1*); Anon. (*722*); Sasaki (*2*); Satō (*1*); Nunome (*1*).

[d] Yabuuchi (*11*); Sun (1); Yabuuchi (27); Chung Kuang-Yen (*1*); Li Chhiao-Phing (2).

[e] Charleston (1), pp. 63–81; Burnham (4), pp. 25–45; Burnham (2), pp. 29–35; Burnham (1); Lubo-Lesnichenko (1); Riboud (1), pp. 93–116; Vial (1), pp. 117–41; Riboud and Vial (1). In addition to the works mentioned above, various publications appear in the *Bulletin de Liaison*, Lyons.

[f] Hsio-Yen Shih has cited fifty-six titles of Chinese publications concerning the history of textiles in her article 'Textiles Finds in the People's Republic of China', pp. 305–21. In addition there are a few titles concerning textile technology: Shih Hung-Ta (*1*); Li Chhung-Chou (*2*); Li Chhung-Chou (*3*); Sung Po-Yin and Li Chung-I (*1*); Tuan Shih (*2*); Sung Chao-Lin (*1*); Anon. (*752*); Anon. (*756*); Anon. (*641*); of the works published in Taiwan we will mention only the articles by Tsou Ching-Heng (*1*) and (*2*), and that by Than Tan-Chhiung (*1*), pp. 1–33.

Containing information and correlating minor details that have previously either been overlooked or not considered seriously, it provides at least a working idea of how and when the spindle-wheel evolved.[a]

(1) ARCHAEOLOGICAL AND PICTORIAL EVIDENCE FOR THE SPINDLE-WHEEL

To organise the material as clearly as possible without neglecting historical evolution, it is necessary to organise the archaeological and pictorial evidence separately from the textual sources. The former will be dealt with first. There are good reasons to proceed in such a way. Over the years many papers have been published in Chinese which explain the terminology of the spindle-wheel on the basis of definitions in well-known dictionaries and agricultural encyclopaedias, but unfortunately, none of these etymological attempts has been able to throw any light on the history of the device. Chinese scholars took the pictorial evidence available as reference material but did not attempt to find economic or other reasons for the invention of the spindle-wheel.[b] Here the question will be tackled from this latter but neglected point of view.

It will be appropriate to begin by indicating once more the place of spinning within the whole process of textile manufacture. As is well-known, weaving is done on a loom. But before the loom can be used, it must be supplied with yarn which has gone through various stages of preparation, depending on the final characteristics and quality required. When silk is used, it has to be reeled before the 'spinning process'—here used as a general term to include spinning, doubling, etc.—can be carried out. After spinning, warping the warp-beam and dressing the loom take place. Only then can the actual weaving begin.

Examination of surviving textiles and textile impressions on artifacts has shown that reeled silk was used in China as far back as Shang times or earlier.[0] Such material evidence leads one, therefore to think that some processes in the technology of silk-spinning (e.g. spooling, throwing, doubling, and spinning waste silk) were employed in China as early as the Shang. As has been demonstrated elsewhere,[d] the variety of silk threads found is rather large, ranging from threads with no twist at all, by way of silk threads with a loose Z-twist,[e] to Z-twisted threads with 2500 to 3000 twists per metre, and a thread in S-twist with 2100 to 2500 twists per metre. The latter are rather strongly twisted, causing a crêpe-effect which may be described as a tendency of the threads to curl and shrink in both warp and weft.'

* The basic ideas of this chapter are already contained in Kuhn (6).

[b] Sun Yü-Thang (/) ; the previously mentioned work of Shih Hung-Ta; the articles by Li Chhung-Chou; the relevant chapter in Anon. *(644),* pp. 61-7; and Kao Han-Yü and Shih Pai-Khuei (/). Also see Wang Jo-Yu *(4),* pp. 5-7.

[c] Sylwan (2); Wang Jo- Yü (/), pp. 49-53; Anon. *{757),* pp. 3-8, pi. 10; Kuhn (7), pp. 61-2; Kuhn (8), pp. 382-3. [d] Kuhn (8), p. 382. <> Sylwan (2), p. 122; Kuhn (8), pp. 382-4.

' Kao Han-Yü (/), pp. 47-8; Kuhn (8), p. 382. Chinese textile historians named the silk thread *chou-sha'.*

[1] 縐紗

Such crepe-threads had a width of 0.1 mm in warp and 0.3 mm in weft.[a] This relatively fine and highly twisted material could have been produced by the spindle-whorl, but a spindle-wheel was certainly better suited for such a delicate task, and more efficient. As is known from oracle-bone inscriptions and as may be deduced from its political and economic importance as well as the technological equipment, in Shang times sericulture was most probably a state-monopoly, as was bronze manufacture. Organisation of the workshops, which were managed by artisan-officers, was directed towards economic efficiency; this led to what can only be described as forced-labour conditions for the artisans.[b] It is in this social-economic context, that discussion about the spindle-wheel in China should start.

Many years ago Joseph Needham had already assumed that it would be rather surprising if the reeling-frame were not at least as old as the quilling-wheel.[0] The reeling-frame certainly is older than the quilling-wheel (= spindle-wheel), and simple types of it—details of which are unknown—had been used during the Shang. There is one convincing reason for this: a silk thread with a continuous length of 800 m to 1000 m, or even longer, could only be obtained by unwinding the cocoons soaked in either hot or cold water. A reel was indispensible for this, and when actually doing the unwinding and operating the reel by hand, the labourer could watch the cocoons rotate. This rotation occurs because the silk fibre is wound around the cocoon in a figure 00 shape, and when the reel is put to work and the fibre drawn off, the cocoon rotates. If the cocoon is replaced by the spindle-whorl filled with spun yarn, and the yarn then connected to a reel which is turned by hand, yarn will be transferred from the spindle-shaft to the reel. This is one possible explanation of how it may have started, but certainly is not enough to explain the origin of the spindle-wheel. Indeed, for hemp, ramie, and bast fibres in general, there was no need to wind the spun yarn on to a reel; further processing could be performed without such a step. It is therefore necessary to look again into the silk processing.

In winding or throwing—a procedure to be dealt with later after silk-reeling has been discussed—the silk threads went from the silk-reel to small hand-reels, and no spindle-wheel was needed. But for the processes of doubling and weft quilling, a spindle-wheel facilitated the work immensely. So the idea may have developed of using the hand-driven reel as a sort of driving-wheel which rotates an empty spindle by means of a driving-belt. In the processes of doubling and quilling, the empty spindle is filled with twisted thread which now combines two or three threads into one. Such an economical and time-saving device was certainly welcomed in the Shang silk workshops because 'spinning' a certain amount of thread always took far longer than weaving it into fabric.[d] Furthermore, quality control improved because the labourer could use one hand to drive the spindle-wheel, while the fingers of the other hand controlled the combined threads feeding the spindle. But whether the spindle-wheel was known in Shang times or not will

» *Ibid.*
[c] Vol. 4, pt. 2, p. 108.
[b] Kuhn (8), p. 400.
a See above, *(c),* (2), (iii).

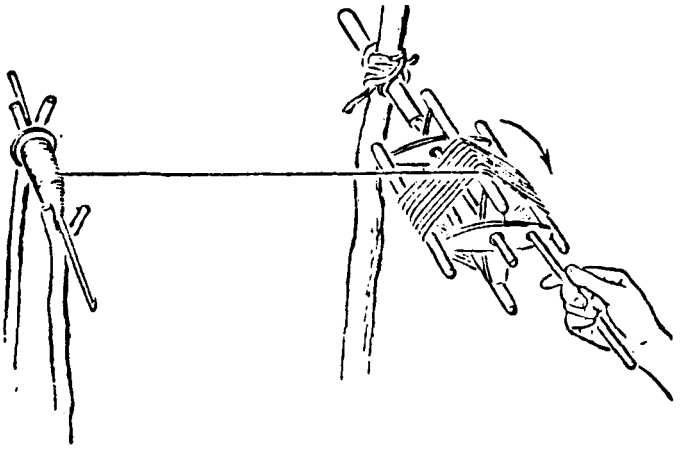


Fig. 98. Winding yarn from a spindle-shaft on to a reel. Anon. (*644*), p. 63.

probably remain an insoluble problem, because so far neither material nor any other evidence is available. Nevertheless, we can be certain that two technical preconditions for the invention of the spindle-wheel were already present in Shang China. Firstly, people were already familiar with the operation and rotation of the reel used in silk-reeling. They certainly knew how to wind a skein from the rotary silk-reel on to small spools, and they knew how to double silk thread. For this purpose it was most convenient to arrange the spindle and the axle of the reel parallel to each other in a horizontal position, because a horizontal spool prevents the threads from slipping off as is easily the case with a vertical one. As soon as the advantage of such a horizontal arrangement was understood, (Fig. 98) and seen to be suitable for winding thread either from left to right or from right to left as required, it would have been used also to wind the spun yarn of plant fibres from hand-spindles for further processing. In this process, the hand-spindle is also placed horizontally (instead of vertically as when spinning). Secondly, wheels for vehicles had been introduced to China from the ancient Near East or western Asia in the middle of the — 2nd millennium,*[1] so by the Chou period the Chinese must have had considerable experience in wheel construction.

It has been assumed that the spindle-wheel was welcomed in the Shang work-shops, though there is no evidence for such an hypothesis. With Chou times one is, however, on safer ground, for there are three factors which indicate that a change in spinning technology must have taken place, most probably in the Warring States period (— 463 to -221), or even by the Spring and Autumn period (— 770 to — 463). The first of these is the dramatic reduction in the number of spindle-whorls excavated, the second the increase in those silk fabrics having

[a] Vol. 4, pt. 2, pp. 73-4. Textile historians like Chou Chhi-Chheng and Kao Han-Yü hold the opinion that the vehicle wheel in ancient China was quite different from that of the ancient Near East. (Private correspondence, 10 May and 21 June 1984.) But the difference in structure does not exclude the introduction of the vehicle wheel to China from outside.

twisted or doubled threads, and the third is the development of the treadle-operated loom. But before entering into a discussion of these factors, the technical function of the spindle-wheel must be explained, as well as the way its use can be distinguished from that of the spinning-wheel; in addition something must be said about the geographical area in which the spindle-wheel most probably originated. Furthermore, for a better understanding of the whole situation it is essential to explain the wide range of its applications in the textile industry. Only then can it be fully appreciated how important was the invention of the spindle-wheel to the manufacture of textiles.

(i) *The Construction of the Spindle-wheel and its Working Methods*

If the vertically worked hand-spindle with its whorl is suspended horizontally between two short uprights so that it can revolve (Fig. 100), it is called a spindle-wheel, following a suggestion by Patterson.[8,] The spindle was mechanised, with the whorl acting as a pulley, having a groove cut into it to take the driving-belt. At the other end of a base-board are two long uprights supporting the axle of the driving-wheel, which the spinner rotates by a crank held in the right hand. The driving-wheel itself could have been constructed in several ways, but from pictorial evidence, it tends to be shown as a wheel with spokes terminating in grooved blocks on which the driving-belt was carried. These blocks could be connected to one another on either side by a rim, but that was not absolutely necessary—rimless driving-wheels were, and still are, common in China.[b] Thin cords connected the outwardly diverging spokes, forming a 'cat's cradle' that carried the driving-belt. Despite its name, which means 'spinning (of fibres)', the Chinese spindle-wheel was not originally used for spinning but doubling and quilling of silk threads, processes which improve the quality of silk to be used in weaving but, all the same, do not transform raw material into yarn. In practice, the doubling process is easier to perform than spinning, so it may be correct to assume that silk-doubling was followed by the doubling of all types of threads. Only after some experience had been gained with doubling on the spindle-wheel, was this device taken over for use in spinning plant fibre yarn. One must, therefore, distinguish doubling and spinning as the two separate working steps which could be executed on the spindle-wheel. The stone-rubbing that best demonstrates the process of doubling is from Shantung province and may be dated as belonging to Han times." It shows the labourer using one hand to control the thread when feeding the spindle, the threads themselves coming from two small reels standing on the floor. These are drawn to a guiding-hook, fixed to a horizontal bar. There the doubling—the twisting together of the two single threads into one thread in a

[a] **Patterson (i), p.** 203.

[b] **Vol. 4,** pt. 2 above, p. 103: 'Rimless driving-wheels are also common in Chinese textile technology.' Op. cit., p. 80, (e) 'For it is indeed true that in some types of Chinese spinning-wheel *(fang-chhe)* the crank-**or** pedal-operated driving-wheel has no rim at all, the belt being carried on grooved blocks **at the** ends of the spokes.'

[c] Pictured in: Sung Po-Yin, Li Chung-I (/), p. 23: fig. 1.

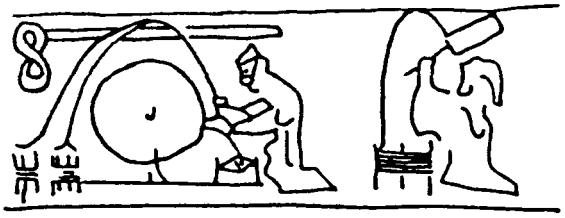


Fig. 99. Doubling or quilling (left) and throwing (right) of silk, Han dynasty. Kuhn (6), p. 23, fig. 1. The stone-relief which we have redrawn was found in 1930 in Theng-hsien in Shantung province. It is pictured in Fu Hsi-Hua (1), vol. I, no. 91; Sung Po-Yin & Li Chung-I (1), p. 23, fig. 1; Satō Taketoshi (1), vol. I, pl. I.

direction opposite to that in which they themselves are twisted—takes place (Fig. 99). With the right hand the spinner turns the crank of the driving-wheel which is linked to the spindle by a driving-belt.[a] The result is a Z-twisted thread, consisting of two S-twisted ends produced by the counter-clockwise motion of the wheel. Such threads were used for the warp in China.[b] Although the connection between the driving-wheel and the spindle is not shown here, there was no other way of making the spindle-wheel work. If weft-threads are twisted on the spindle-wheel it usually is called a quilling-wheel. The spinner had to sit behind the wheel, as she does in another relief from Kiangsu province, and the bearing of the quilling-spindle had to be turned at an angle of $90^{0}.^{0}$ The arrangement of figures and machinery in the Han reliefs was determined purely by the conception and skill of the artist, which at that time was still very limited; perhaps that is the main reason why the worker is sitting beside the wheel and not in her proper place. Normally the right hand turned the driving-wheel and the left hand guided the quilled thread, and there can be no doubt that in our stone-rubbing, too, the quilling was managed in exactly the same way.

It may be concluded that different names refer to different functions of the spindle-wheel but not to different devices. That the development—spooling later followed by spinning—took place as just outlined can also be seen from thirteenth and early fourteenth century western illustrations picturing the spindle-wheel.[d] They also show clearly that the spindle-wheel was first used for continuous working processes, and later on for spinning, and then only for certain qualities of yarn for which it proved suitable. How did the spindle-wheel work when spinning yarn and how is it different from the European spinning-wheel? These are the questions which should be answered next.

The processes performed on the spindle-wheel so far described could be done continuously, which means the driving-wheel was in constant rotation. Spinning

[a] For a discussion of driving-belts in China, see Vol. 4, pt. 2, pp. 8, 55, 83, 95, 102-5, [10]7~8> [3]^1> Hommel (1), p. 173, fig. 251. The stone-reliefs from Han times are the oldest illustrated sources proving the existence of continuous driving-belts in China.

[b] Burnham (5), p. 56.

[c] See also, *TKKW*, ch. shang, p. 34a; *PFKI*, ch. 3, p. 15.

[d] Delaporte (1), vol. 2, pi. CXXIX; vol. 3, pi. CCLXXI; Patterson (1), fig. 183 *{Ypres Book of Trades, c.* +1310); Gutmann (1), p. 466; Vol. 4, pt. 2, p. 106; Baines (1), p. 55, fig. 15 (early + 14th century miniature from Royal MS 10E IV., f. 146); fig. 16 (miniature from *Luttrell Psalter,* + 1338. MS 42130, f. 193).

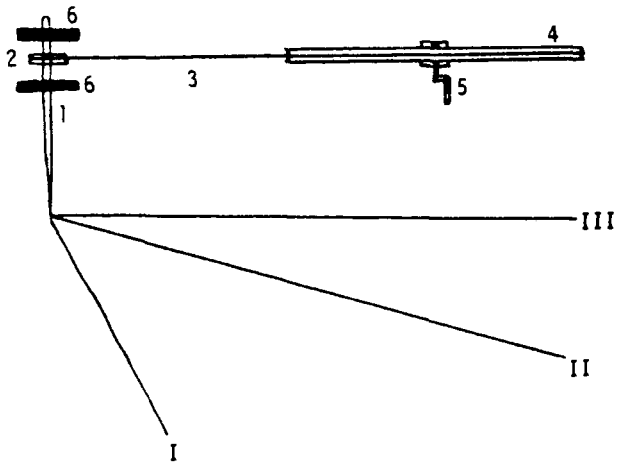


Fig. 100. Spindle-wheel. I. Spinning. II. Drawing-out. III. Winding, 1, Spindle. 2, Pulley. 3, Driving-belt. 4, Driving-wheel. 5, Crank. 6, Short uprights.

on the spindle-wheel can in theory be divided into three actions (Fig. 100): I. Spinning; II. Drawing-out; III. Winding.

I. Spinning: in general the spinner turns the wheel with her right hand. The left hand holds the prepared fibres. She attaches the fibres to the spindle and moves her hand away from it roughly at an angle of about 45^0 to the spindle. The fibres are turned into yarn by the rotating spindle. By means of this rotation, the yarn is wound spirally along the spindle until it slips off the end. II. Drawing-out: the yarn is then drawn out to the length of the outstretched arm. This regulates the thickness and the degree of twist. If it is drawn out at an obtuse angle to the spindle, the twist of the yarn will be looser; if approaching 90^0, it becomes tighter. III. Winding: the spinner has drawn out her arm while the driving-wheel continues to rotate, and now she has to decide when to stop the wheel; her decision is based on the degree of twist required, because as long as the wheel turns, twist is added. Once a length of yarn has been completed, the thread is held at right angles to the spindle and wound on to it. To bring the yarn from the top of the spindle into the winding position, and to reduce the risk of entanglement when the yarn is unwound later, the driving-wheel has to be stopped and operated in the reverse direction for a few turns. Then the yarn is finally wound on to the spindle. The process is repeated until the spindle is filled.[8] All this means that continuous spinning is not possible on the spindle-wheel: the action is still divided into two steps: spinning and drawing-out, and then winding-on, as it is with the hand-spindle. The twist put in to the components of yarn depends on the way in which the spindle is connected to the driving-wheel by the driving-belt, presupposing that the driving-wheel is always worked in a clockwise direction. Judging by all illustrations so far examined, there is but a small probability that a closed type of

» For more detailed information see Baines (1), pp. 40-4; Fannin (1).

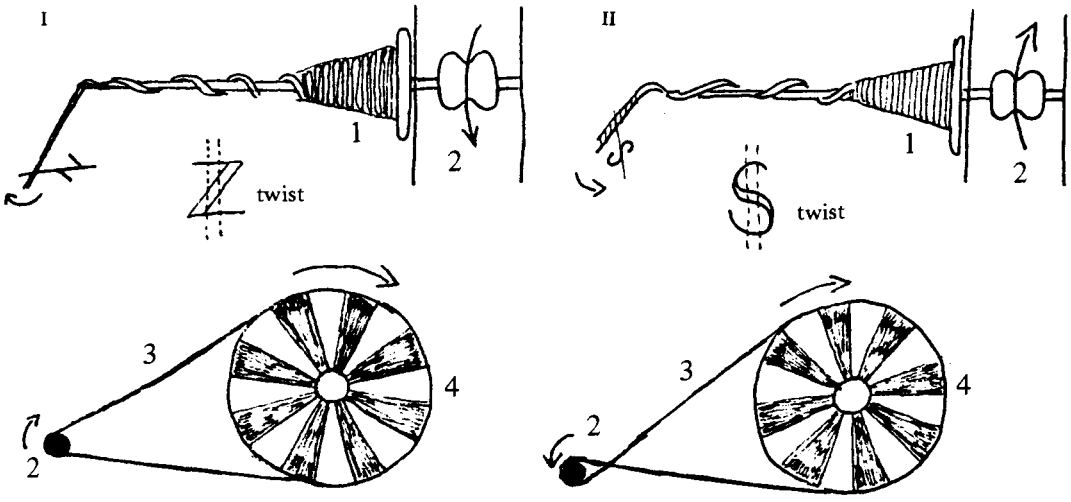


Fig. 101. Driving-belt arrangements: I, open band; II, closed band. 1, Spindle. 2, Pulley. 3, Driving-belt. 4, Driving-wheel.

band was ever used in China, but for technological reasons it must be mentioned here (Fig. 101).

When the spindle and the driving-wheel are connected by an open band, and the driving-wheel is worked clockwise, the spindle also turns to the right causing the yarn to twist from right to left towards the spinner. The Z-twist or right-spun yarn appears. To produce the left-spun S-twist the driving-belt is crossed over before it encircles the pulley. This driving-belt arrangement is called a closed band.

Patricia Baines has commented about the spinning direction:[a] 'Some people argue that if the thread is looked at from the other end, the direction of twist will change, but this is a fallacy: while clockwise and anticlockwise and left and right do change this is not so with S and Z; whichever way you look at the thread the direction of the twist is constant.'

(ii) *Spinning-wheel and Spindle-wheel: Origin and Distribution*

The spindle-wheel was the first and only labour- and time-saving device developed for the production of yarn and thread before the invention of the spinning-wheel with its flyer in +i5th century Europe. As far as is known, the latter was exclusively used for spinning but, for the first time, made it possible for this to be a continuous process. The spinning-wheel with a flyer or Saxony wheel, was first illustrated in *Das Mittelalterliche Hausbuch,* about + 1475 to + 1480, from Schloss Wolfegg near Lake Constance in southern Germany.[b] This does not mean,

[a] Baines (i), p. 44. Fig. 101 is also based on a similar drawing by Baines (1), p. 43, fig. 4.

[b] Essenwein (1), pi. 34a; Bohnsack (1), 'Entwicklung und Durchsetzung des Flügelspinnrades', pp. 139-43; Feldhaus (1), pp. :061-25 Baines (1), p. 85.

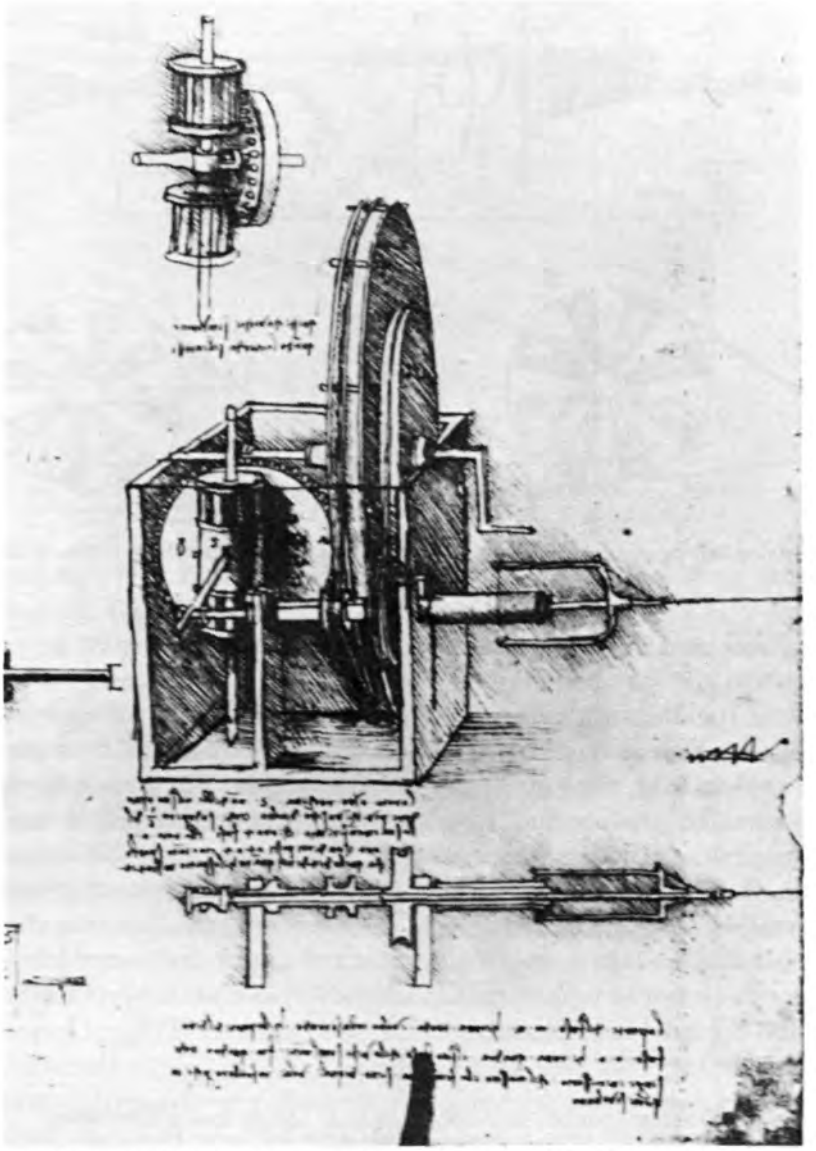


Fig. 102. Drawing of a flyer by Leonardo da Vinci, *c.* +1490. *Codice Atlantico* of the Biblioteca Ambrosiana, Milan, reproduced from Ponting (1), p. 31.

of course, that it was invented in southern Germany but merely that it was already known there in the last quarter of the + 15th century. Leonardo da Vinci was also interested in mechanisms for spinning, twisting and winding yarn, as is evident from his collection of papers and drawings known as *Codex Atlanticus.* He may have drawn the spinning-wheel with flyer about + 1490 or a few years later.[a] His idea

[a] Feldhaus (1), pp. 1063-4, '065; Abb. 712-13; Baines (i), pp. 84-5; *Codex Atlanticus,* p. 393va; reproduced in Ponting (1), p. 31.

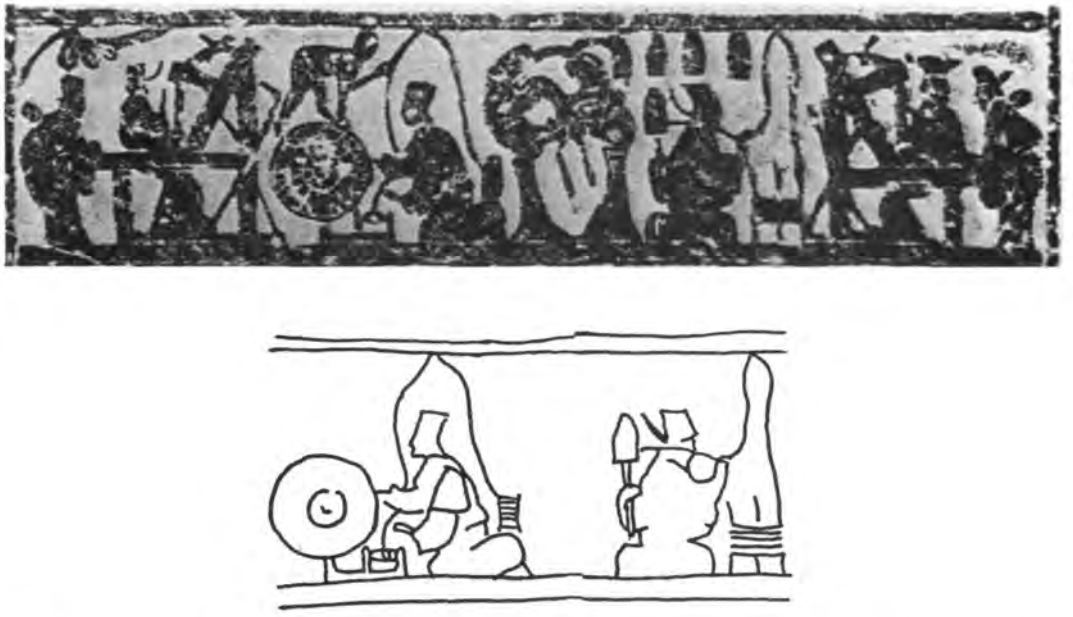


Fig. 103. Weaving on a treadle-loom, spooling on a spindle-wheel, throwing of silk thread, weaving on a treadle-loom (from left to right), Theng-hsien, Shantung province, Han dynasty. Sung Po-Yin & Li Chung-I (*1*), p. 23, fig. 2. The stone-relief was found in 1952 in Theng-hsien, Lung-yang-tien, Shantung province. It is now in the Li-shih po-wu-kuan, Peking. We find it pictured in Lubo-Lesnichenko (1), pl. III, no. 4; Finsterbusch (2), vol. 2, Taf. 240: 5; Satō Taketoshi (*1*), vol. I, pl. 2. The spooling and throwing redrawn from the stone-relief. Kuhn (6), p. 24, fig. 2.

for constructing the spindle with bobbin and flyer was technically and economically the most advanced of its time. Bobbin and flyer were driven by separate driving-belts, the flyer doing the twisting, the bobbin the winding-on, thus combining the process into a single action. In addition, the bobbin moved to and fro, thus insuring that the yarn was laid evenly on it[a] (Fig. 102).

The main advantage of this new spinning device was that the whole process of spinning, drawing-out and winding the yarn was continuous, unlike the Chinese practice. It would lead far beyond the scope of this study to describe the development of the European spinning-wheel flyer, and a return must be made to the subsequent progress of the Chinese spindle-wheel.

Much that has been published about the origin of the spindle-wheel is guesswork, but all the evidence available points at China as the geographical area where it originated. Nevertheless, some scholars maintain that it came from 'the East';[b] others put it more exactly by specifying the Far East," and as has already been

* For further discussion, see Bohnsack (1), 'Kontinuierliches Spinnen mit dem Flügelspinnrad', pp. 134-9. Patterson (1), p. 205; Usher (1), pp. 270-4; English (2), pp. 4-7; Leadbeater (2), pp. 6-9; Reti (1), p. 265.

[b] Feldhaus (1), p. 1059; Usher (1), p. 268; White (22), p. 119; Lach (5), vol. 1 : i, p. 81; English (2), p. 2.

[c] Patterson (i), p. 208; Leadbeater (2), p. 4.

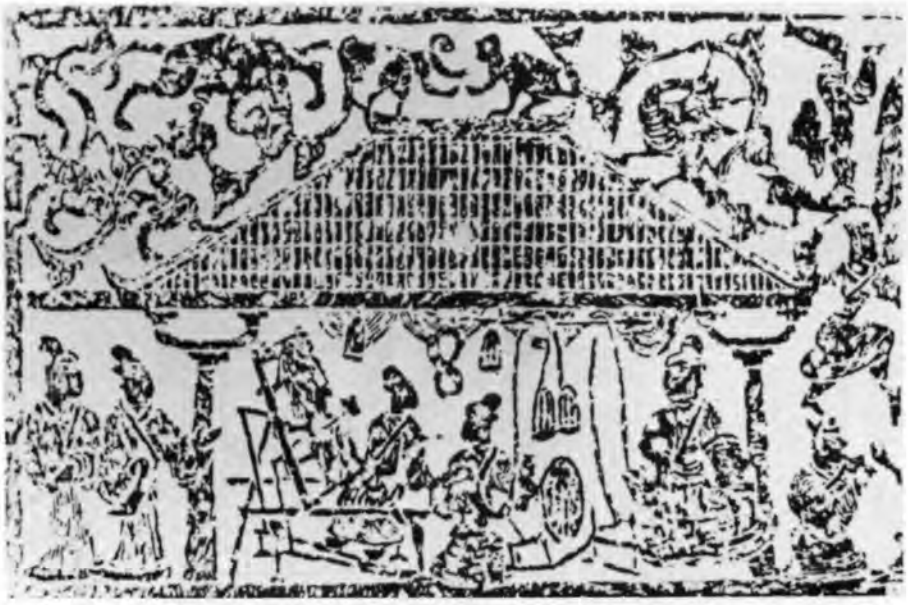


Fig. 104. Weaving on a treadle-loom, doubling silk threads (from left to right), Thung-shan-hsien, Kiangsu province, Han dynasty. Sung Po-Yin & Li Chung-I (*1*), p. 24, fig. 7. This stone-relief was found in 1956 in Thung-shan-hsien, Kiangsu province. It is pictured in Anon. (*624*), ill. 51; Lubo-Lesnichenko (1), pl. III, no. 3; Ohta Eizō (*3*), fig. 107; Finsterbusch (2), Taf. 157, no. 594; Hsia Nai (*9*), p. 21, fig. 8; Anon. (*607*), fig. 2; Satō Taketoshi (*1*), vol. I, pl. 7.

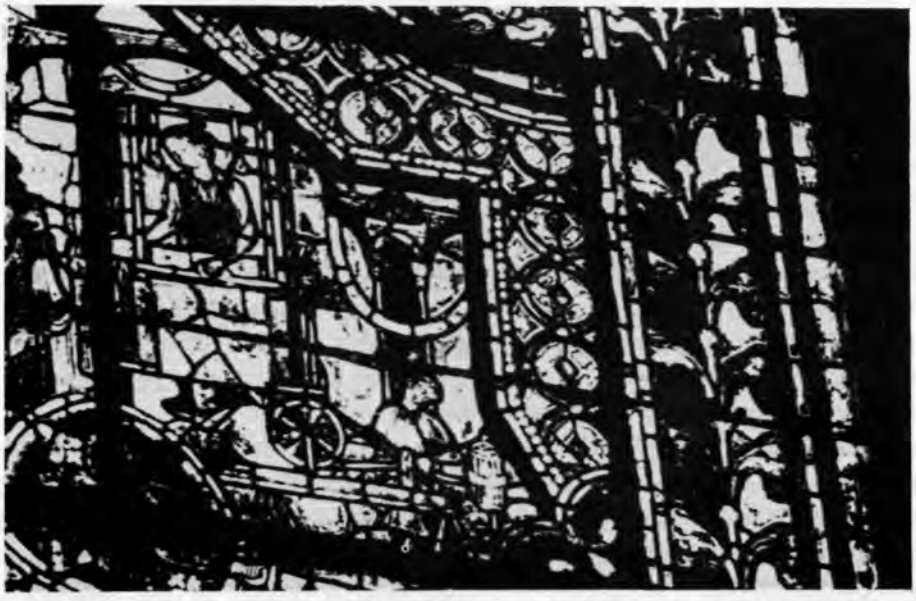


Fig. 105. Quilling-wheel from the windows of Chartres cathedral, +1240 to +1245. Delaporte (1), vol. 2, pl. CXXIX in bay XLIII; Delaporte (2), p. 55, pl. 27, 'un atelier des tisserands'.

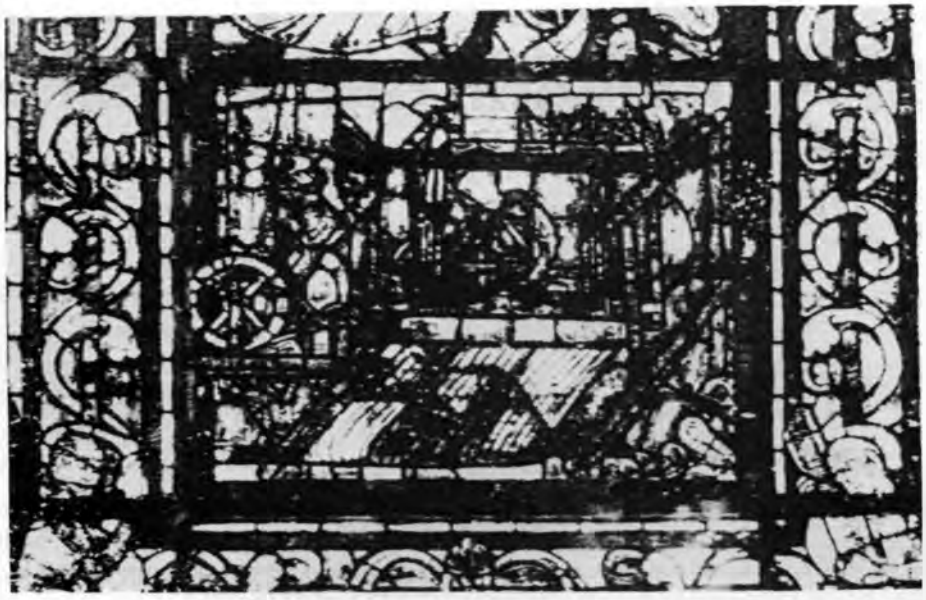


Fig. 106. Quilling-wheel from the windows of Chartres cathedral, +1240 to +1245. Delaporte (1), vol. 3, pl. CCLXXI in bay CLXX.



Fig. 107. Woman spinning and man carrying loaves, illuminated manuscript of the Decretals of Gregory IX, early +14th century. Royal MS 10 E IV, f. 146, reproduced from Baines (1), fig. 15.



Fig. 108. Spinning and carding, miniature from the *Luttrell Psalter*, between +1335 and +1340. MS 42130, f. 193, reproduced from Patterson (1), fig. 167.

shown, and will continue to be demonstrated, its invention in Europe can be ruled out completely." However, there does not seem to be any evidence that the spindle-wheel is of Indian origin.[b] Certainly, India was the home of cotton culture and thus of short-staple cotton technology, but there is no reason to connect the use of cotton to the invention of the spindle-wheel. Moreover, though scholars generally date the putative Indian invention of the spindle-wheel to the second half of the + ist millennium,[0] depictions of the spindle-wheel in stone-reliefs of the Han dynasty show that it was much earlier in China (Fig. 103; Fig. 104).

The oldest pictorial representations in Europe of spindle-wheels can be found on the windows of Chartres cathedral (+ 1240 to + 1245)[11] (Fig- 105; Fig. 106) in France and in the *Tpres Book of Trades (c. + 1*310) ,[e] in an illuminated manuscript of the Decretals of Gregory IX, written in Italy but illustrated in England from the early + 14th century[1] (Fig. 107), and in the *Luttrell Psalter,* commissioned by Luttrell of Irnham in Lincolnshire, and most probably made in East Anglia

[a] Forbes (2), p. 115; White (5), pp. 46-7.

[b] Feldhaus (2), pp. 45, 81; Mumford (1), p. 144; Parish (1), p. 570; **Born (4), pp. 1097-8; Leroi-**Gourhan **(i),** p. 260; Schwarz (2); Forbes (13), vol. 4, p. 156. The hand-spindle was **used in the Vedic** period in India; see Rau (1), pp. 16-17; Baines (1). p- 44 quotes **Irfan Habib (source not provided):** 'whereas Sanskrit appears to lack any word for it, the term in use in most **northern Indian languages and the** one also carried to Nepal is the Persian name for it " *charka "*. He also says **that in texts where the spinning-**wheel might well have been mentioned, it is not, nor have any **illustrations come to light.' Dietrich (a), p. 114.**

[c] Born (4), p. 1097; Forbes (13), p. 156 (—500 to +750).

« Delaporte (i), vol. *2,* pi. GXXIX; vol. 3, pi. CCLXXI; Vol. 4, pt. 2, p. 106; White (5), p. 46.

[e] Gutmann (1), p. 466; Patterson (1), fig. 183.

* Carus-Wilson (2), vol. 2, ch. 6, pi. IIb, c; Usher **(1),** p. 267; Vol. **4, pt. a, above p. 103; Baines (i), PP-** 54-5» [fi]g- '5-

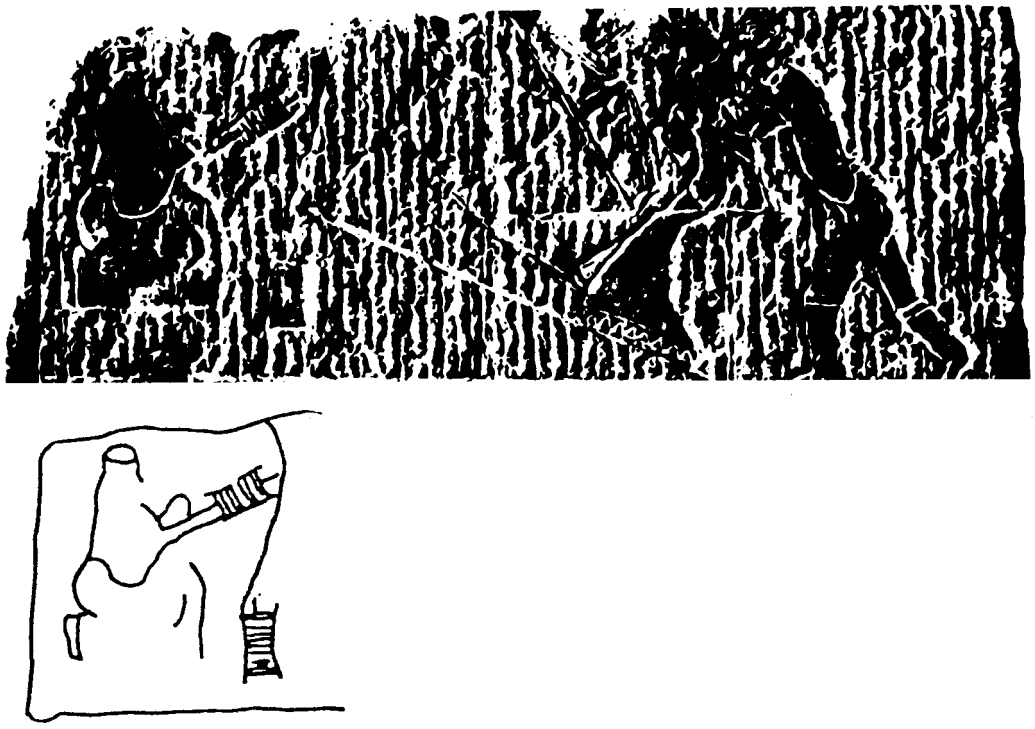


Fig. 109. Throwing silk thread and weaving on a treadle-loom, Han dynasty. Sung Po-Yin & Li Chung-I (*1*), p. 23, fig. 4. The redrawing was made by us.

were any knots or other damage to the thread. The worker wound it with the right hand by moving the throwing-pole in a clockwise direction. The result was a thread with a slight twist. This is the method pictured on the reliefs.

A great number of descriptions and illustrations explaining and depicting these working devices exist (Fig. no; Fig. in). Most of this textual tradition is based on the *Nung Shu* of + 1313 as a source,[a] but there are also the chapters of the *Thien Kung Khai Wu* of + 1637, the *Pin Feng Kuang I* of + 1742 and the *Tshan Sang Tshui Pien* of + 1899, which differ from the *Nung Shu* in that they provide additional information which had not been previously recorded.[b] Apart from the traditional texts, illustrations of great variety giving evidence of regional characteristics in textile technological craftsmanship, are also to be found.

[a] *NS*, ch. 21, pp. nb-i7a; ill., pp. nb, 15b; *NS* (+ i530-ed.), ch. 24, pp. ia~3b; ill., pp. lab, 2ab, 3a; (the arrangement of the text and illustrations of the two iVS-editions differ from each other; ch. 21 also contains text and illustrations of warp and weft preparations on pp. I2b-i5a while the +1530 edition shows the technologically logical sequence of working-steps); *NCCS*, ch. 34, pp. 8b-çjb; ill., pp. 8b, ga; *STTH, (chhi-yung)*, ch. 9, pp. 3ib~32b; ill., pp. 310-323; *SSTK*, ch. 74, pp. I2a-i3a; ill., pp. 12a, 13a; *PMTT*, ch. 1, p. 14b; *KCTSCC*, ch. 218, *tshe* 798, pp. ib-2b; Franke (11), fig. XCIV; Pelliot (19), pi. XIX.

[6] *TKKW*, ch. *shang*, pp. 3ia-32b; ill., p. 33b; *PFKI*, ch. 3, pp. sb-6b; ch. 1, p. 12b; *TSTP*, ch. 5, pp. ia-5b; ch. 11, pp. 37ab; ch. 12, pp. 24ab.



Fig. 110. Spooling-reel (lo-chhe), +1639. *NCCS*, ch. 34, p. 9a.

During the days of Wang Chen in the early years of the +i4th century, the hand-reel was made of bamboo and its name explained the procedure in which it was employed: the labourer holds the device in his hand and moves it round and round in a controlled motion. From this came the name *tiao-huo*[1] 'shaking' or 'moving' hand-reel, to distinguish it from the revolving reel. To work it, the two sets of spokes needed a hole to take the axle of the device, while the extension of the axle beyond the body of the reel functioned as the handle. The earliest thread-winder or reel still extant was excavated in Sinkiang and dates from the Chin dynasty (+265 to +420). It is made of wood and measures 19.8 cm in length (Fig. ii2).[a] But as will become evident, employing the small reel as a hand-reel meant that it could be used not only in the spooling process, but also for doubling, and for weft- and warp-making. In all these procedures the

[a] Anon. *{675)*, M- 43-

[1] 掉籗



Fig. 111. Spooling-reel (lo-chhe), +1313. *NS* (+1530 ed.), ch. 24, p. 3a.

hand-reel or small reel was the carrier of the silk threads being processed. As to these various functions, more details will be given later.

The pre-Han history of the spooling-frame is not known, but it may be assumed that during the Chou period changes in spooling technology took place. From Han stone-reliefs it is clear that various methods of spooling were practised, employing the throwing-pole with the reel (Fig. 109), skein frames of various sizes, and even a spindle-wheel (Fig. 103). Terminological variety not only accounts for the widespread use of this technique but probably also for regionally distinct conceptions of how to manufacture spooling-frames and how to make them work. Hence the use of one or the other method does not necessarily imply a higher or lower standard in the quality of textiles, but more probably provides evidence of a regional tradition of craftsmanship which would not be abandoned except for economic reasons. The history of spooling methods in China, as far as it seems possible to trace it, puts strong emphasis on this point.

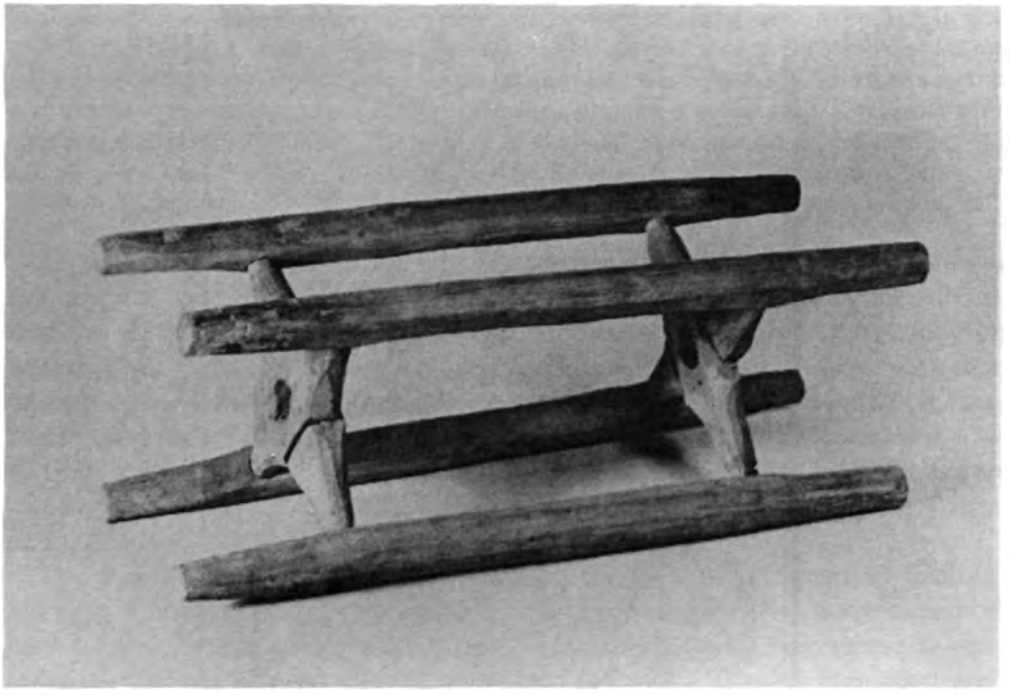


Fig. 112. Thread-winder or reel, Chin period (+265 to +420), length 19.8 cm. Anon. (*675*), ill. 43.

Two major winding or spooling methods were in use: hand-spooling **with a** throwing-pole and drag-spooling (Fig. 113). The *Tshan Sang Tshui Pien* **(General** Compendium on Sericulture) says:[a]

There are two methods of spooling silk: drag-spooling *{sheng-chhe*[1]*)* and hand-throwing *(shou-phao*[2]*).* When spooling silk *{chieh ssu*[3]*)* both methods have their advantages. They are similar to each other but when thinking of the silk then drag-spooling is not as convenient as hand-throwing. Weavers weaving gauze (/0[4]) and tabbies *(chiian*[5]*)* employ female labourers spooling silk threads by the drag-spooling method; weavers weaving satin *(tuan*[6]*)* and pongees *(chhou*[7]*)* employ male labourers who prefer the throwing method for spooling silk threads.

From this description it is clear that the method applied depended on the quality of silk thread required for a certain type of fabric. The one device both methods had in common was a spooling-frame[b] *(lo-tu*[&]*)* (also known as a strand frame, skein frame and winding-frame). It was made of strong but fine wood which was expensive and not easy to obtain, such as pear *(tu-mu*[9]*),*[0] chestnut *(li-mu*[10]*),*

» *TSTP,* ch. 5, p. 2a. [b] *TKKW,* ch. *shang,* p. 31a.
[c] *TSTP,* ch. 5, p. 1a. It is most probable that a pear is meant by the author, but other trees should not be excluded because the character *tu* appears frequently in plant names.

[1] 繅車 [2] 手拋 [3] 解絲 [4] 羅 [5] 絹
[6] 緞 [7] 綢 [8] 絡筲 [9] 杜木 [10] 栗木

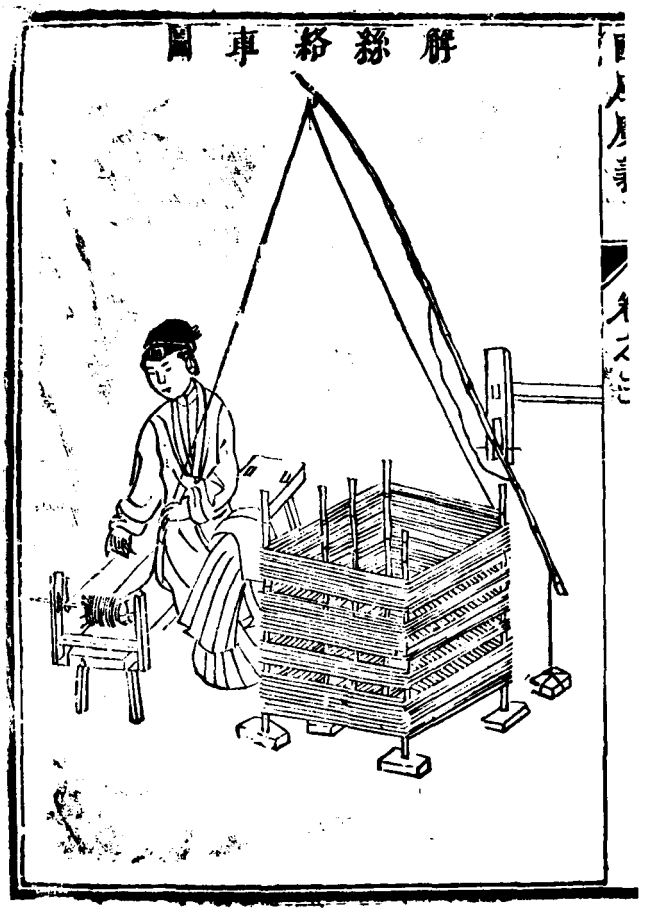


Fig. 113. Drag-spooling silk and the spooling-reel (*chieh-ssu lo-chhe*), + 1742. *PFKI*, ch. 3, p. 6a.

peach *(thao-mu[1])*, probably the cypress *(tkao-po-mu[2])* and the *Machilus nanmu (hsiang-mu[3]*; perhaps *hsiang-nan-mu*)*.[a] A hook had to be fixed on a crossbar above the worker, and an experienced female or male craftsman performed the work.

Here it is worth consulting the *JVung Shu* (Book on Agriculture) of + 1313 to learn about the technique in which drag-spooling was performed:[1]*

After the silk threads have been taken off from the silk-reel *(khuang[5])*, they are drawn onto the strand frame *(ni[6])*. Above (the working place either on a pole or in the ceiling) a hook is fixed hanging down. The end of the skein of silk thread is drawn through it and on to the reel *(chhe[1])*. The structure of the reel consists of a fine axle *(hsi-chou*)* perforating a small reel *(huo[9])*, which is placed between the two uprights of the reel-frame.

» *TSTP*, ch. 5, p. ia. » *MS*, ch. 21, p. 16b.

[1] 桃木 [2] 桃柏木 [3] 香木 [4] 香南木 [5] 軠
[6] 柅 [7] 車 [8] 細軸 [9] 籗

It should be noted that one upright only is high with a groove going through in the middle; this is the bearing of the head of the reel-axle. The short upright serves to control the end of the axle. When the labourer pulls the string, the axle moves which causes the reel to follow its rotation. The silk thread then is drawn on to the reel. This is the silk-spooling reel of north China. The people in the south practice only (the method of) throwing the reel *(tiao-huo*[1]) to obtain the silk threads. After all (the throwing-reel) is not as safe and fast as the spooling-reel. Nowadays the latter is most commonly used.

To the northern drag-spooling method, employed by women, some information from the *Pin Feng Kuang I* (Enlarged Explanations of the Sericultural Crafts of Pin) and the *Tshan Sang Tshui Pien* (General Compendium on Sericulture) may be added. They explain that the small reel was made of wood or bamboo with four or six rails and a fine axle, commonly called *lo-chien*[2].* A hempen string 64 cm long surrounded the axle at the right hand side and was kept in its proper position by a piece of leather. The labourer alternately dragged the string, then let go, so causing the spindle and the reel fixed to it to rotate. The left hand fed the thread and guided it.

The throwing method *(phao-fa*[3]*)* was widely known in 19th century Chih-li, Kiangsu, Chekiang and Szechwan.[b] Originally it had been the southern method used by men, where a hand-reel *(lo-tzu*[4]*)* was attached to a long throwing-pole *(phao-kan*[5]*)* about 64 cm long.[c] For spooling weft silk a wooden four-sided reel with a length of 17.6 cm and a diameter of 8 cm was used; for warp silk a round bamboo reel with six rails of the same length but with a diameter of 13.44 cm was customary. Of course, the warp reel could take more silk.

Spooling not only put a slight twist into silk thread but also made it possible to find 'secondary fibres' *(khen po*[6]*)*[A] which the spinner removed so that they did not cause additional work when the silk was woven and starched.

• The strand frames[6] *(lo-tu)* for spooling were mostly very simple, though two other types can be distinguished—one from Kiangsu and Chekiang, and the other from Szechwan. In the former the framework was arranged in a cross-shape[1] (Fig. 114), while the latter is shown in an illustration in the *Nung Cheng Chhiian Shu* (Fig. 115).[8] In the *Tshan Sang Tshui Pien* there is a description[11] which explains wooden boards are arranged parallel to the floor (length 169 cm, width 6.4 cm and a height of 4.8 cm). It also says that there are five bamboo poles each measuring 128 cm which are fixed to each board, though Fig. 115 shows only four, two for each board. In addition, there is a third board; this passes at right-angles through the middle of the other two and acts like a wedge *(hsieh*[7]*).* It holds the outer board tightly, but keeps the inner one—nearer to the spinner—

[a] *PFKI,* ch. *hsia,* p. 5a. [b] *TSTP,* ch. 5, p. 2b.
[0] *Ibid.* [a] *Ibid.*
[e] The various terms will be discussed below, ch. *(d).* (2).
[1] *TSTP,* ch. 5, p. 4a. » JVCGS, ch. 34, p. 9a. * *TSTP,* ch. 5, p. 4b.

[1] 掉籰 [2] 絡尖 [3] 拋法 [4] 絡子 [5] 拋竿
[6] 哨剝 [7] 楔



Fig. 114. Spooling-frame of the Chekiang-Kiangsu type, +13th century. This type of spooling-frame is depicted on a scroll by Liu Sung-Nien (active *c.* +1174 to +1224) of which only the relevant section is reproduced here (see Fig. 1). A description of the spooling-frame can be found in *TSTP*, ch. 5, p. 4a.
The scroll is preserved in the National Palace Museum, Taipei (VA 35c).

movable. When the spinner moves her foot on the wedge, she is able to change the tension of the strand whenever this seems necessary.

Apart from the traditionally widespread techniques of drag-spooling and throwing, spooling and quilling using the spindle-wheel were well-known and practised (Figs. 118, 119). This immediately raises the question why the silk spinning spindle-wheel is neither described nor depicted in well-known pre-Chhing agricultural works. There may be several reasons for this. First, ordinary people probably preferred the simpler techniques which used devices that were quickly and easily manufactured. The spindle-wheel was needed in their households for spinning hemp, ramie and cotton. Secondly, regarding silk pre-Chhing textual sources demonstrate that the spindle-wheel was geared to spooling silk by winding or quilling. When quilling, the small spindle which takes the thread may have been large enough to be used afterwards as a bobbin in the shuttle, but when spooling, the thread had to be wound round a hand-reel for further processing with the result that a small reel with a fine axle had to be used

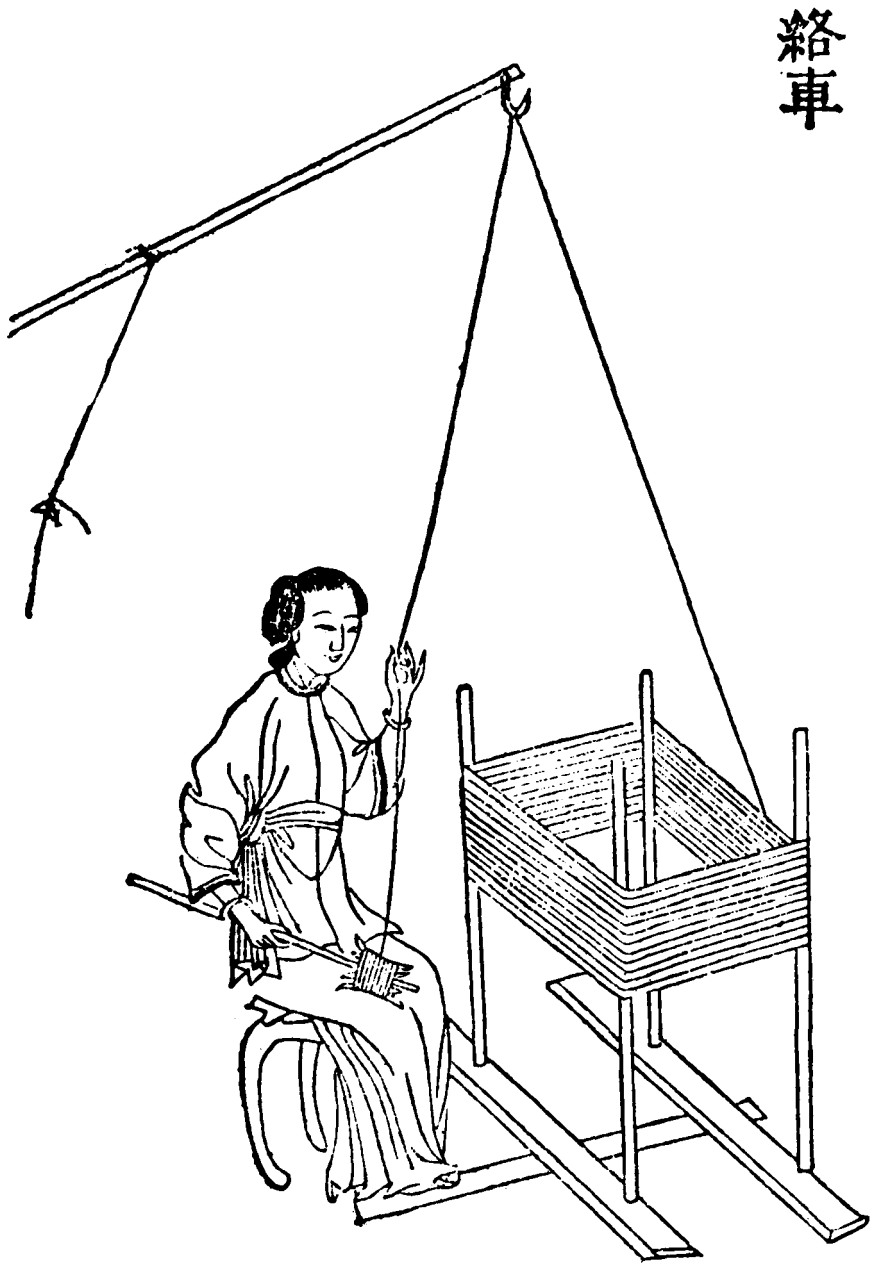


Fig. 115. Spooling-frame of the Szechwan type, +1639. *NCCS*, reproduced from *NCCSCC*, ch. 34, p. 946.



Fig. 116. Quilling-wheel, section from the handscroll 'Ladies' Book of Filial Piety' (*Nü Hsiao Ching*), attributed to Ma Ho-Chih (active *c.* +1140 to +1190), but most probably later, *c.* end of +12th or early +13th century. National Palace Museum, Taipei, Taiwan, *Ku-kung shu-hua lu* SH 35'c, Archive 2868.

instead of a spindle. But this would necessitate the provision of two uprights as bearings for the reel's axle, otherwise the small reel would start to wobble and go out of control. Regrettably, Chinese artists cared about such technological considerations in only a few cases; mostly they did not distinguish between spooling and quilling, and so the two techniques cannot be discussed separately; if they were, a description of the pictorial evidence would become rather repetitive.

It is not necessary here to count by how many years the pictures and illustrations of Chinese spindle-wheels precede the European medieval depictions—this has already been done by Joseph Needham.[8,] Nevertheless, besides the stone-reliefs of Han times, there are a few pictorial sources from the Sung even earlier in date than those so far published.[1]» These show various types of spindle-wheels, and from them it is possible to distinguish three different purposes for which the device

[8] Vol. 4, pt. 2, pp. 103-7: he explains in detail the illustrations of the *Keng Chih Thu* (Pictures of Tilling and Weaving) and dates the pictures of the Semallé Scroll as + 1237. This year is given because 'About + 1275 the painter Chheng Chhi[1] made a series of illustrations based on those of the printed edition of Wang Kang[2] & Lou Shao[3] in +1237', and as Needham continues 'illustrations which cannot have diverged far from those of + 121 o, and no doubt resembled fairly closely the original paintings of Lou Shou[4] himself (+ 1145) '. For more information on the illustrations of the *Keng Chih Thu*, see Kuhn (2), pp. 336-67.

» Vol. 4, pt. 2, pi. CLIII, fig. 408 (stone-engraving of + 1769 after Chheng's scroll, rediscovered in the + 18th century); pi. CLI, fig. 405, painting attributed to Chhien Hsiian[5], datable about + 1270. Also see Waley (19), pi. XLVII.

[1] 程棨 [2] 汪砢 [3] 樓杓 [4] 樓璹 [5] 錢選

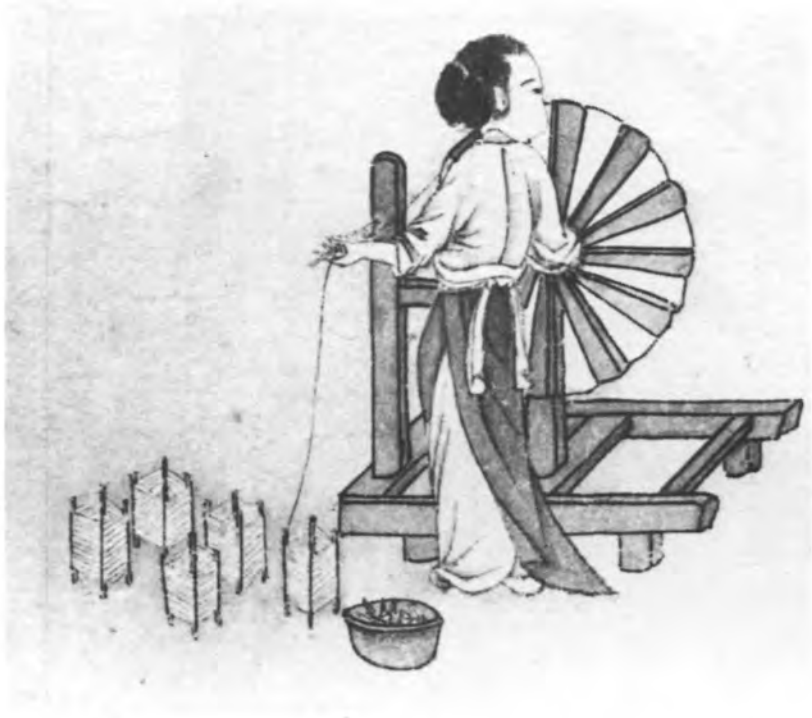


Fig. 117. 'Quilling' on the spindle-wheel, section from the handscroll *Tshan Chih Thu* by Chheng Chhi, *c.* +1275. Freer Gallery of Art, Washington D.C., Negative No. 5420–28.

was used—for quilling silk thread, for spooling it, and for spinning yarn. The first two of these were often confused in Chinese sources.

In the National Palace Museum, Taipei, the handscroll in nineteen sections entitled *Nii Hsiao Ching*[1] (Ladies' Book of Filial Piety) is preserved.*[1] Chinese tradition attributes it to the Sung painter Ma Ho-Chih[2] (active about + 1140 to + 1 igo),[1]* but for various reasons it appears reasonable to date it somewhat later, perhaps even to the early + 13th century.[0] Here, however, the problem of dating can be ignored, simply because a technological tradition is depicted which has not changed from Han times to the present day. The section of concern here illustrates three women and a maidservant doing needlework and quilling (Fig. 116). The woman working the wheel, which displays the features of a composite cartwheel with a grooved rim to guide the driving-belt, sits behind it on a woven mat. The wheel rotates when the crank fixed in its centre is turned, and a driving-belt sets the spindle in motion. Four small reels, standing on the ground, deliver the silk

[a] National Palace Museum, Taipei, Taiwan, *Ku-kung shu-hua lu* SH 35'e, Archive 2868.
["] Cahill (1), p. 143.
[c] *Ibid.*, p. 144; H. Franke (19), p. 104.

[1] 女孝經 [2] 馬和之

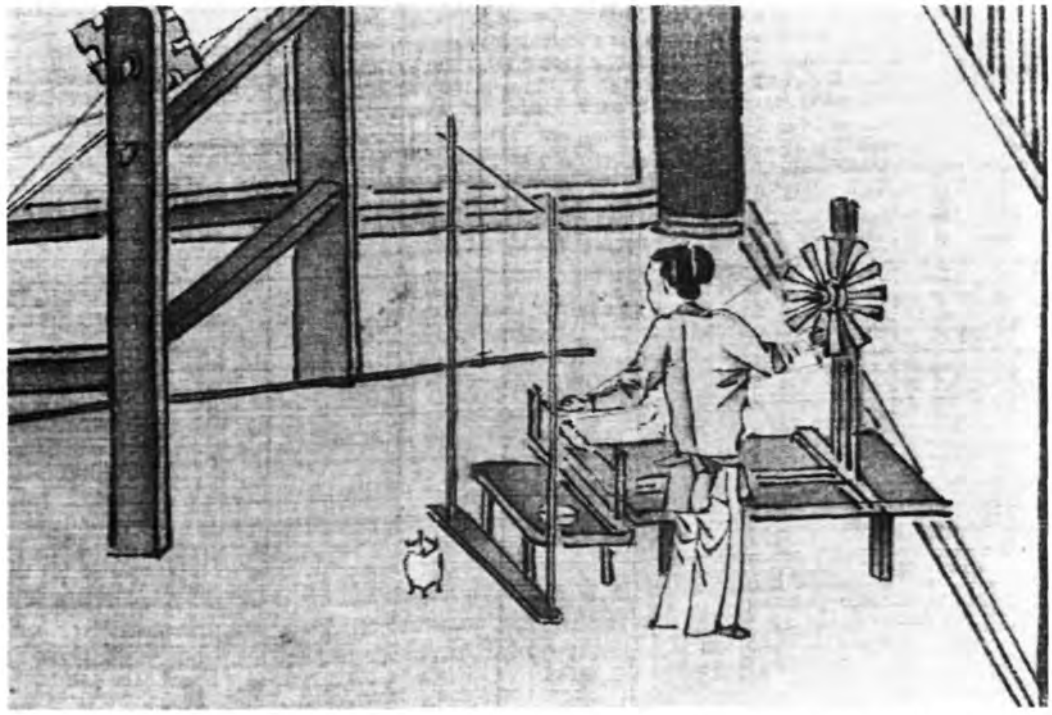


Fig. 118. Spooling on the spindle-wheel, section from the handscroll 'Sericulture' attributed to Liang Khai, *c.* first decade of + 13th century, but most probably later. The Cleveland Museum of Art, Cleveland, Ohio (77, 5, detail of section 3), (Purchase, John L. Severance Fund).

threads to a ring fastened on the arm of a pole. There the threads are quilled into one by combining them and drawing them down to fill the spindle.

Another quilling-wheel of slightly different construction is depicted in the handscroll *Tshan Chih Thu*[1] (Pictures of Silk-weaving), dated about +1275[8, ant^] by Chheng Chhi[2], an otherwise unrecorded painter who may have lived between about + 1250 and + 1320.[15] The quilling-wheel (Fig. 117) mounted on a wooden frame is of the rimless type. Its spindle is not near to the baseboard but fixed to a post approximately at the height of the quilling-wheel's crank, so the operator works it from a standing position. From the illustration, it is not possible to decide whether spooling or quilling is being performed, but considering that only one thread is being processed, spooling appears the more likely. There is a poem in the background of the scene by the Chhien-lung emperor, while another poem

» Vol. 4, pt. 2, above, p. 106.

[b] Lawton (i), pp. 54-7; Cahill (1), p. 263; Kuhn (2), p. 338; Hummel (23), p. 219; Pelliot (24), p. 86; Franke (14), p. 184.

[1] 蠶織圖 [2] 程棨



Fig. 119. Quilling (*fang-wei*), +1637. *TKKW*, ch. *shang*, p. 34a.

(on the right-hand side) is by Lou Shou[1], and was composed in + 1145* It runs as follows:[1']

Steeping the weft, again,[0] is part of the mystery,
And with hands as cool as the bamboo shoots of spring,
The country maidens marry two fibres of silk
And twist them together into one inseparable thread
Fitted to play its part in myriad patterns.
And now, at last, in the late slanting radiance,
The big wheel's shadow looks like the toad in the moon.[d]
Yet still, here below, sweet Ah Hsiang speeds her turning,
And under a deep blue vault the rumbling goes on.[e]

[a] *Keng Chih Thu Shih* (Poems for the Pictures of Tilling and Weaving), p. 8a.
[6] The translation is quoted from Vol. 4, pt. 2, p. 107.
[c] In the passage just cited, Needham writes that this refers to one of the degumming processes. It may, however, not be so; it could well be that 'steeping' means that the threads are moistened by water or sprinkled with water.
* Vol. 4, pt. 2, above, p. 107(d): (The) outstretched spokes (of the wheel) without a solid rim make it look like a spread-eagled toad *(chhan[2])*.
[e] The rumbling describes the noise of the wheel when it rotates.

[1] 樓璹 [2] 蟾

From many illustrations and the inscriptions going with them, the general impression is that the Chinese official-scholar-painters could have had only a very vague idea of what they were talking about, otherwise quilling and spooling would not have been mixed up. Other examples of this prevalent confusion can be found in the + 1739 (?) edition[3] of the *Keng Chih Thu* and in the *Shou Shih Thung Khao* (Complete Investigation of the Works and Days) of + 1742. The fact is that while, during spooling, a slight twist is put into a single thread, it cannot be called quilling because that word means combining several threads into one by twisting. The process of spooling on a rimless spooling-wheel is undoubtedly what is depicted on a handscroll titled Sericulture, attributed to Liang Khai[1] and dated as being of the first decade of + 13th century,[b] though a later date appears more probable.[0] The wheel stands on a low table, and the operator works the wheel with her right hand, guiding with her left the thread which she draws from the reel on the floor (Fig. 118).

As well as in the illustrations identified above as being correctly drawn, the quilling-wheel is thoroughly depicted in the *Thien Kung Khai Wu* (Exploitation of the Works of Nature) of + 1637 by Sung Ying-Hsing,[d] (Fig. 119) in the *Pin Feng Kuang I* (Enlarged Explanations of the Sericultural Crafts of Pin) of +1742 by Yang Shen,[e] (Fig. 120) and in the *Tshan Sang Tshui Pien* (General Compendium on Sericulture) of + 1899 by Wei Chieh.[f]

Another type of ' quilling '-wheel is mentioned in the description in the *Nung Shu* (Book on Agriculture) of +1313 by Wang Chen[2].[8] Unfortunately there is no picture of the wheel described, but only of another one which is a spooling-wheel[11] (Fig. 121). However, the 'spindle-above-the-driving-wheel' has been reconstructed in a drawing (Fig. 122) based on the *Nung Shu* text and another pictorial source which explains it as follows:[1]

On the baseboard *(fu[3])* (of the device) a post is erected where the (driving-)wheel (with its axle) is placed. Above the wheel, very near to it, a fine bamboo spindle *(hsi-thung*)* perforates an iron piece (which keeps the spindle in horizontal position). The driving-belt *(huan-sheng[s])* goes round the wheel and the spindle. If the right hand turns the wheel, the spindle follows the wheel's rotation (and revolves). The left hand draws

• Franke (n), p. 134, pi. XC; as the late Prof. Fuchs has discovered the year of + 1739 is wrong, the edition should be dated between + 1751 and +1769. See, Fuchs (8), p. 71; Kuhn (1), pp. 70-1; *SSTK*, ch. 75. PP- !5[ab]-

•> Anon. (604), no. 61, pp. 78-80: (77.5, detail of sect. 3; purchase John Severance **Fund); Kuhn (7),** P- 77-

[c] Cahill (1), p. 132: not in (Liang Khai's) style.

a *TKKW*, ch. *shang*, p. 34a. [e] *PFKI*, ch. 3, p. 15a.

t *TSTP*, ch. 11, p. 38a, ch. 3, p. 9b. Here the text of the *NS*, see below, is quoted without giving **the** reference.

8 *NS* (+ 1530 edition), ch. 24, p. 6a. [fc] *Ibid.*, ch. 24, pp. sab.

[1] Franke has already translated the same text from the *SSTK*, ch. 75, p. 15b in Franke (11), P- '77- **The** translation is completely wrong; Franke neither understood the construction nor the function of **the** wheel.

[1] 梁楷 [2] 王禎 [3] 枡 [4] 細筒 [5] 環繩

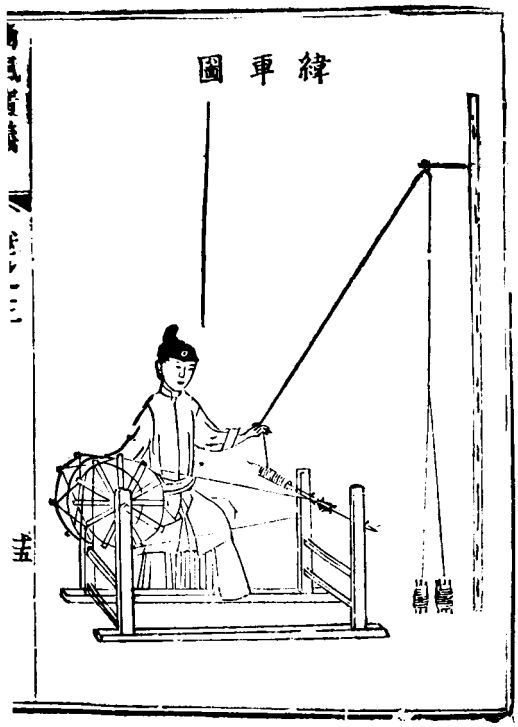


Fig. 120. Quilling-wheel (*wei-chhe*), +1742. *PFKI*, ch. 3, p. 15a.

the silk threads up to the spindle which then completes the quilling of the silk threads *(chheng ssu sui*[1]*).*

However, from the other handscroll entitled Ladies' Book of Filial Piety (Fig. 116) it may be deduced that the painter, for reasons of composition, has left out the post carrying the ring through which the threads from the reels pass prior to being guided to the spindle by the labourer. Here the woman evidently draws the silk threads from the reels and feeds the spindle by hand, and in the reconstructed drawing, the usual practice of quilling has been taken into consideration and the arm with a ring added.

Perhaps a few additional details about this wheel should be given at this point. Mostly it was of rimless construction with several spokes which were connected crosswise by strings. Sometimes two long pieces of bent bamboo were fixed around the two sides of the rim, being tenoned by the spokes. A device to guide the driving-belt may sometimes have been used; this was the so-called crow-beak *[ya-chhiieh-khou*[2]*)* .[a] The spindle, made of bamboo, was as strong as a chopstick and about 12.6 cm long.[b] The shortness of the spindle also indicates that the wheel was not used for spinning, where the spindles are normally longer.

» *TSTP*, ch. 5, p. 7a. [b] *PFKI*, ch. 3, p. 14b.

[1] 成絲緷 [2] 鴉雀口

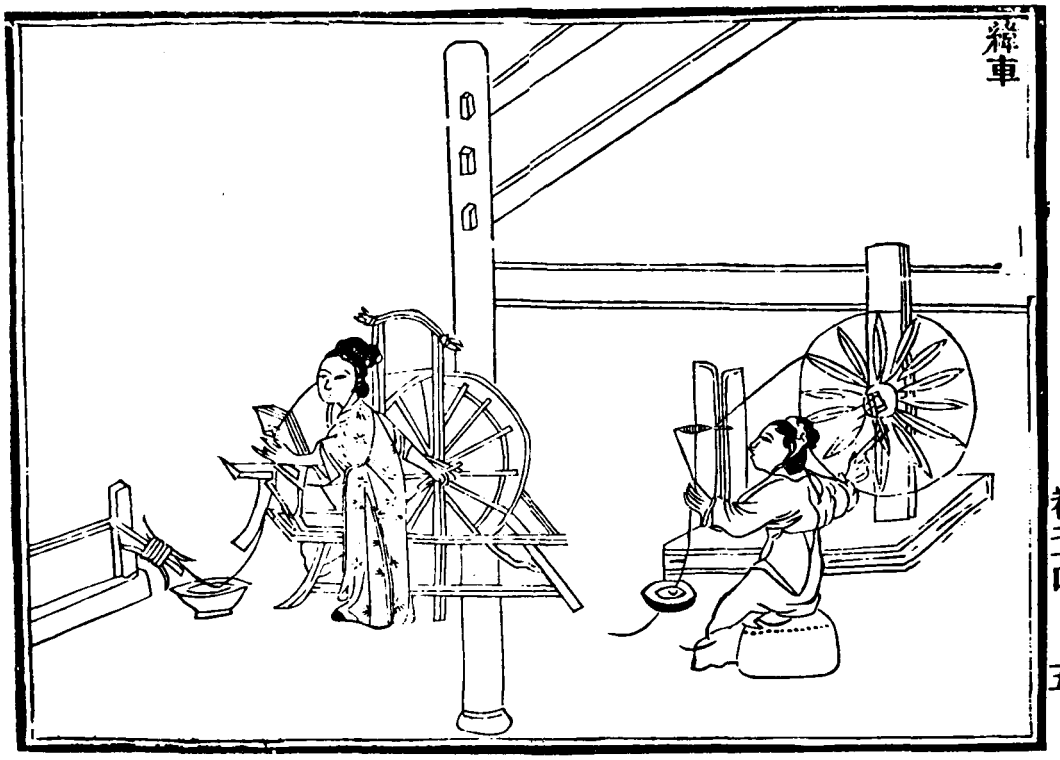


Fig. 121. 'Quilling'-wheel (*wei-chhe*), +1313. *NS* (+1530 ed.), ch. 24, pp. 5ab. (The illustration does not depict quilling correctly; there should be at least two small reels from which the threads are drawn. It might possibly be more appropriate to label the illustration 'spooling thread on the spindle-wheel'.)

Before quilling the threads begins, they are sprinkled with water. The *Thien Kung Khai Wu* tells us that three-fifths of the silk threads were used for the weft and two-fifths for the warp.[a]

Pictorial evidence from Sung times indicates, then, that the type of wheel shown in Fig. 116 was used not only for quilling silk thread but also in the manufacture of strings.[b] Indeed, the many illustrations of what may be termed a 'spindle-above-the-driving-wheel' prove how common this type of wheel then was, and give evidence of its use in the quilling process. But are these the earliest references to it and, if not, when did it first appear?

(a) *Spinning Waste Silk on the Spindle-wheel*

To answer these questions it is necessary to take a big leap backward in time because no evidence could be found between Sung and Han times, although it

» *TKKW,* ch. *shang,* p. 31b.

[b] Another quilling-wheel of the 'spindle-above-the-driving-wheel'-type is depicted on a section of the handscroll jV« *Hsiao Ching Thu* (Ladies' Book of Filial Piety) by an anonymous painter **of the Northern Sung** dynasty, *c.* +nth century. Regrettably the quality of the picture is too poor for reproduction; Mu I-Chhin (/), pi. on p. 182.

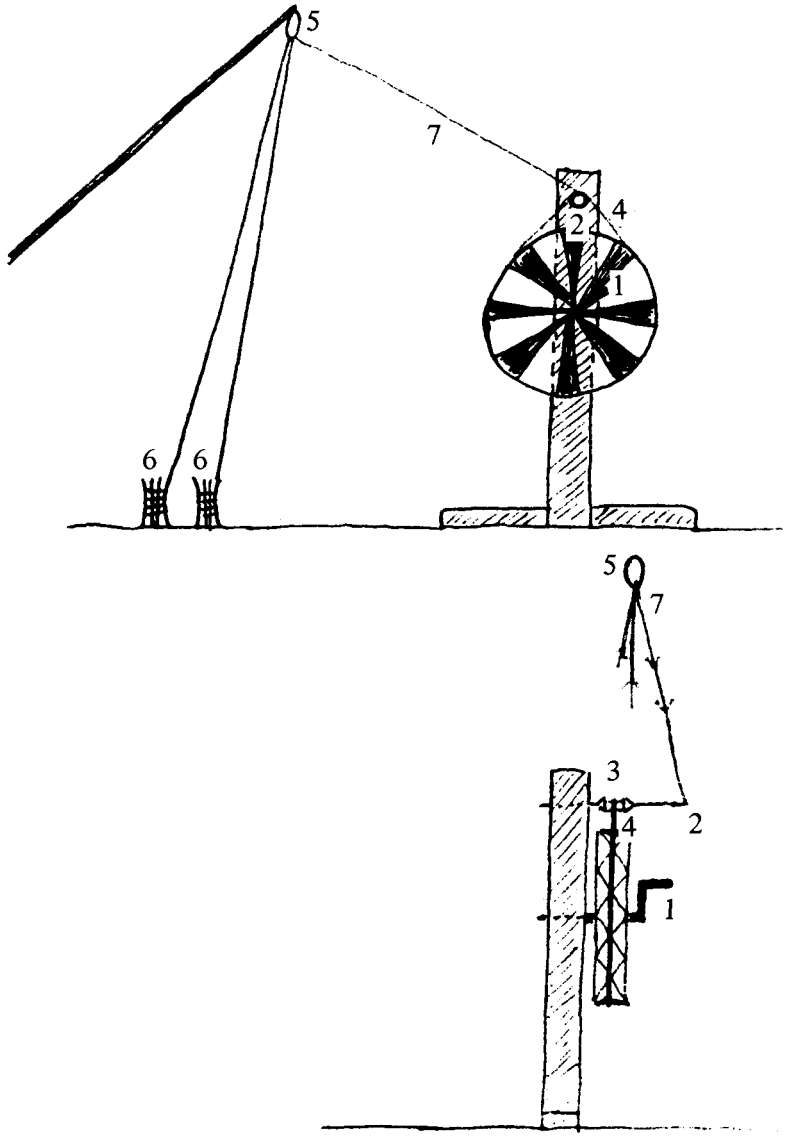


Fig. 122. Reconstruction of the quilling-wheel 'spindle-above-the-driving-wheel' as described in the text of the *NS* of +1313. 1, Crank. 2, Spindle. 3, Place where the spindle is driven by the driving-belt of the driving-wheel. 4, Driving-belt. 5, Hook or ring. 6, Small reels. 7, Here the hand of the labourer guiding the thread should be imagined.

must once have existed. However, a scene from a wall painting excavated in Lin-i[1] county, Shantung province[8,] allows this problem of early evidence to be clarified. This picture, dating from the Han period, has been redrawn by Chinese archaeologists, and on the right half of the fourth scene from the top we find the spinning

» Liu Chia-Chi, Liu Ping-Sen (i), pp. 28-31.

[1] 臨沂

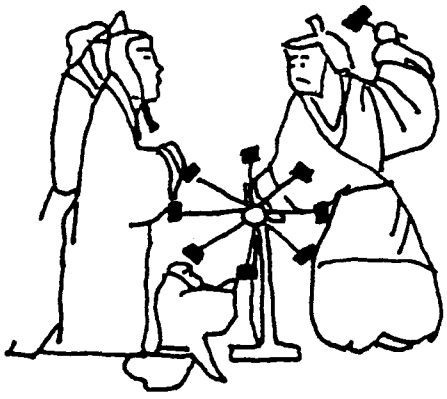


Fig. 123. Spinning waste silk, Shantung province, Han dynasty. Liu Chia-Chi & Liu Ping-Sen (*1*), p. 31, fig. 5. The redrawing was made by us. It has already been published in Kuhn (6), p. 24, fig. 5.

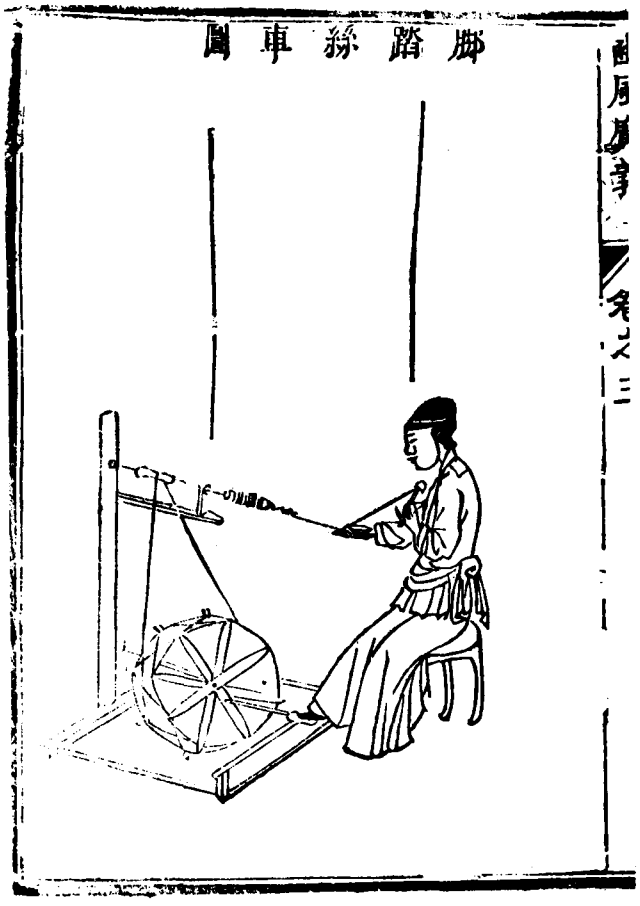


Fig. 124. Spinning waste silk, +1742. *PFKI*, ch. 3, p. 3b.

process illustrated (Fig. 123). Here a woman is placed behind the post supporting the wheel, holding in her left hand a hammer-like object; the action of the right hand is hidden behind the wheel-post. A child kneels on the ground in front of the wheel and stretches its right hand towards the wheel, while two people are standing on the left side watching the woman. At first this seems to be an illustration of 'throwing silk', but no wheel is involved in the Chinese throwing process; furthermore, throwing was generally done with the right hand. All the other working steps like spooling (without a skein frame?), or quilling (without at least two reels?) can be excluded, so this leaves only one possibility—the spinning of waste silk *(fang-mien-ssu',* also called *men-mien*[2]*).*[11]

The working method was as follows.[6] The left hand held the cocoon stick *(ckien-chu*[3]*)* which was a type of distaff which could take as many as twenty dry or wet cocoons already prepared by boiling and which, under certain conditions, or when arranged very tightly, could resemble a hammer. The right hand pulled *(chhe*)* and spun the yarn, which was wound around a spool set on a -spindle driven by a driving-belt. The article in *Wen Wu* states that the right hand must have turned the wheel, but it seems more likely that the wheel was rotated by the child kneeling in front of it because both the operator's hands would have been needed in the spinning process. Thus there was a division of labour because this spindle-wheel of Han times was operated manually, not by a treadle, so that two persons were needed for spinning waste silk. The spindle had to be placed below the wheel, because there was obviously no other place to attach it. This arrangement was later changed and improved; the new version must have been the 'spindle-above-the-wheel'-type mentioned above. Afterwards, when the treadle-operated spindle-wheel was familiar, one person alone could perform the spinning. This is pictured in the *Pin Feng Kuang* / of + 1742[e] (Fig. 124).

This Han wall painting suggests that the Chinese knew very early how to prepare and spin waste silk, a more difficult process than spinning hemp or ramie because two hands were needed and an additional person required to drive the wheel.

(ß) A Short Excursion into Processing Cotton and Spinning Cotton Tarn

The third function of the spindle-wheel, and the one which was economically the most important was the spinning of hemp, ramie (Fig. 125) and cotton yarn. How it was done in practical terms has already been described.[0]

The oldest depiction of cotton spinning appears as part of a painting attributed to Chhien Hsuan[5] *(c.* +1235 to after +1301), from Wu-hsing in Chekiang

» *NCCS,* ch. 34, p. 17b; *PFKI,* ch. 1, p. 13b.
* *PFKI,* ch. 1, p. 13b; ch. 3, pp. a-3b.
<= *PFKI,* ch. 3, p. 3b. 1 See above, (d), (1), (i).

[1] 紡綿絲 [2] 撚綿 [3] 繭著 [4] 扯 [5] 錢選



Fig. 125. Bast fibre spinning on the spindle-wheel, Kyōto, +1723. *Hyakunin Jorō*, +1723.

province,* probably painted about +i275,[b] where a woman works a rimless spindle-wheel, consistent in type with the others already seen but smaller in size (Fig. 126). We observe the lady in the phase of drawing-out the fibres while working the driving-wheel with her right hand.

Before explaining the widely used (Fig. 127) hand-operated spindle-wheel for spinning cotton, mention should be made of the preparations necessary before the fibre was spun. There are a number of works[0] discussing the processing of cotton, so that we can limit our discussion to a mere minimum of essential background information.

Cotton is a seed fibre not a bast fibre plant, hence its processing differs very much from the preparation of hemp and ramie. Cotton fibres had to be loosened,

» Laing (i), p. 118; Cahill (i), p. 264. Our scroll is not listed under Chhien Hsiian's works.
[6] Waley (19), pi. XLVII: reproduced in Vol. 4, pt. 2, above, pi. CLI.
[c] Vol. 4, pt. 2, above, pp. 102, 105, 122-4, :27> '78, 204; Chao (1); Dietrich (i);ChhenTsu-Kuei (J); Shih Hung-Ta (/); Amano *{12),* pp. 1-45; 37: 2, pp. 199-232; 37: 3, pp. 330-60.



Fig. 126. Woman spinning at the spindle-wheel; painting attributed to Chhien Hsüan (*c.* +1235 to after +1301) with the title 'Son parting from his mother'. Said to be *c.* +1275, but more probably is of more recent date. Waley (19), pl. XLVII.



Fig. 127. Spindle-wheels in the courtyard of a peasant's house, Shanghai, 1930. Thiemann (1), Abb. 74.



Fig. 128. Loosening, selecting and drying the cotton, + 1765. *MHT*, the section of our illustration is a stone-rubbing from + 1877, ill. VI.

selected *(chien[1])*, dried in the sun or open air *(shai[2])*, ginned, bowed and straightened prior to spinning.

The loosening (Fig. 128) was done with big forks or sticks on plaited bamboo mats. After drying, the cotton was stored or brought to the cotton-markets for sale.[a] At the markets of the middle of the + 18th century in north China, cotton had a fixed price, whether the harvest was good or bad, and its market value was determined only by weight. For example, normally one *chin* could be divided into sixteen *Hang;* for cotton, the measure was twenty *Hang* to one *chin* (596.82 g). In a good year, twenty-four *Hang* made one *chin* but fetched the same price.[b] In this way the price remained static, though the quantity of raw material obtained depended on seasonal economic conditions ; it was computed out in *Hang.* Theoretically, then, the price was always the same, but in reality it was manipulated by the quantity. From their takings after the cotton harvest, the peasants bought their rice and salt. This description by the author of the *Mien Hua Thu*° (Illustrations of Cotton Planting and Manufacture) appears to be rather idealistic; reality may have been less agreeable.

* *SIKH,* ch. 2, pp. 2ib-22b.
[b] *Ibid.,* p. 24a.
[c] Below we shall hear something about the *Mien Hua Thu* and its author.

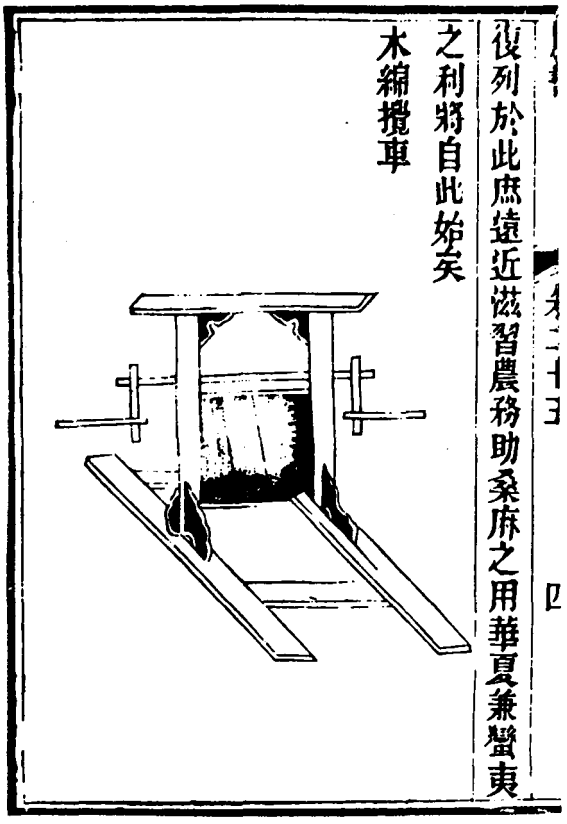


Fig. 129. Cotton-gin (*mu-mien chiao-chhe*), Yüan dynasty. *NS* (+ 1530 ed.), ch. 25, p. 4b; *NS*, ch. 21, p. 27b.

Several names for ginning, such as for example, *ya-ho*[l&] and *kan-mien*[2h] as well as various types of cotton-gins[0] were in use as early as Yuan times. Such were the *chiao-chhe*[3] which was hand-operated (Fig. 129) and *ya-chhe** a hand- and treadle-operated gin (Fig. 130). The *Nung Shu* (Book on Agriculture) of + 1313 reports[4] that in times past the method of 'crushing (the seeds) by rolling the cotton' *(nien-chou*[5]*)* was employed, though this was evidently a very laborious method and one which gave unsatisfactory results. The *Nung Shu* continues that in its time one uses the gin *{chiao-chhe).* The cotton-gin described was fixed on a ground frame, but as can be seen from later pictures, it could also be fixed on a table. On the ground frame were two square-posts about 46 cm high, with both rollers which passed through them having their crank-handles *(tiao-kuai*[6]*)* on opposite sides, one on the right, the other on the left. The upper roller was made

• *SIKH,* ch. *shang,* pp. 23b-24a, pp. 24b-25a.
» *TKKW,* ch. *shang,* p. 24b, pp. 4ib-42a; *KCTSCC. (khao-kung),* ch. 218, *tshe* 798, p. 3b.
[0] *MS,* ch. 21, pp. 27b, 28a; *JVCCS,* ch. 35, pp. 22ab; *SSTK,* ch. 77, pp. I4ab; *KCTSCC,* op. cit., p. 4a.
[d] *NS,* ch. 2i, p. 28a.

[1] 軋核 [2] 趕棉 [3] 攪車 [4] 軋車 [5] 轆軸 [6] 掉枴



Fig. 130. Cotton-gin at work (*ya-chhe*), +1765. *MHT*, the section of our illustration is a stone-rubbing of +1877, ill. VIII; for technical details see Fig. 131.

of iron, the lower of wood. The cotton seeds with the fibres adhering to them were fed into the narrow slit *(hsia[1])* between the rollers, where turning the handles caused the seeds *(ho[2])* to fall to the ground or into a basket while the fibres appeared on the other side. The cotton, including its seeds, was called 'seed-cotton' *(tzu-kua[3])*, and the ginned cotton 'lint-cotton' *(jang-hua*)*.[a] If the quality of the cotton was very fine, then its name was 'pure cotton' *(ching-hua[5], mien-jing[6])*.[b] Cotton of the best type had seven or eight seeds in every section *(pan[1])* and was named 'small white bell' *(hsiao pai ling[9])*.[c]

As already stated, there were several methods of ginning in use. The *Mien Hua Thu* of + 1765 even describes a gin where one roller was alternately turned from right to left, then from left to right, while the other, the lower roller, was held by a hook so as to be unmovable. Yet another method appears in the *Nung Sku*,[A]

[a] *SIKH*, ch. *shang*, p. 24a.

[b] *Ching-hua* is the name recorded in the *SIKH*, ch. *shang*, p. 24a; the term *mien-ying* is from the *NS*, ch. 21, p. 28a.

[c] *SIKH*, ch. *shang*, p. 25a; if the harvest was successful then the peasants got 120 *chin* (≈ 71.6 kg) from each m«; if it was only mediocre then the harvest was about 80-90 *chin* (*c.* 47-54 kg).

[A] AS, ch. 21, p. 28a.

[1] 牌 [2] 核 [3] 子花 [4] 淨花 [5] 瓤花
[6] 綿英 [7] 瓣 [8] 小白鈴

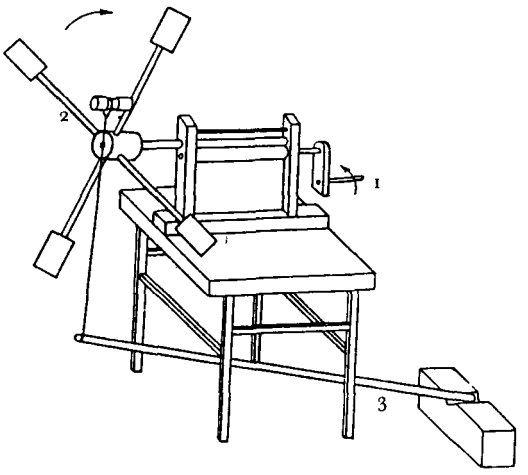


Fig. 131. Cotton-gin worked by a hand-crank and treadle motion assisted by a radial flywheel, +17th century. 1, Hand-crank working the wooden roller. 2, Bob flywheel working the smaller upper roller made of iron. 3, Treadle working the flywheel. Liu Hsien-Chou (5), p. 3.

where we read that two persons worked the rollers, 'mutually ginning' *(hsiang-ya*[1]*)*. In comparison with the 'crushing by rolling' method, this new working technique had the advantage of being several times faster and so more economic. The *Nung Cheng Chhiian Shu* (Complete Treatise on Agriculture) informs* us that there was still a more productive method of ginning, employed by taking the ginning machine from Chü-jung[2] which could be worked very effectively by one person. Joseph Needham[1]" has explained: '. . . an improvement took place in the course of time whereby only the lower roller was worked by a hand-crank, while the upper one (smaller and of iron) was worked by a treadle motion assisted by a radial bob flywheel (Fig. 131).°. . .It probably corresponds to what Hsü Kuang-Chhi early in the + 17th century referred to as the Chü-jung type, named from a city in Kiangsu but more characteristic of the northern provinces' (Fig. 132).

According to the description in the *Thai- Tshang-Ckou Chih* (Local Gazetteer of Thai-tshang-chou),[d] this hand- and treadle-operated cotton-gin was called the Thai-tshang model, named after the region where it was in use in Kiangsu province. It was of the *ya-chhe* cotton-gin type. The sources are contradictory because according to the *Nung Cheng Chhiian Shu,* the Thai-tshang model is more advanced than the Chü-jung model, but on the other hand the text of the *Thai-Tshang-Chou Chih* describes a model which from the technical point of view has to be the Chü-jung type. Without illustrations or more precise descriptions it is not possible at present to come to a final conclusion in this matter.

* *NCCS,* ch. 35, p. 22b. *• Vol. 4, pt. 2, p. 123. [c] Liu Hsien-Chou (5), p. 31.
[d] *Thai-Tshang-Chou Chih,* quoted in the *KCTSCC, op. cit.,* p. 4a.

[1] 相軋 [2] 句容

車攪綿木

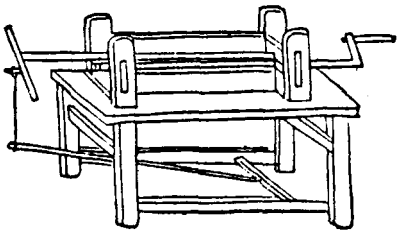


Fig. 132. Cotton-gin of the hand- and foot-operated type, + 1639. *NCCSCC*, vol. 2, p. 976. *Chiao-chhe* is the wrong name; it should be labelled *ya-chhe*.

The cotton-bow *(than-kung*[1]*)*[0,] was used to fluff up the cleaned cotton, and so this task became called 'bowing the cotton' *(than-mien*[2]*)* (Fig. 133).[b] The procedure was that after the cotton was dried, workers started to bow the cotton fibres, using a bow of wood or bamboo having a length of about 120 cm. The waxed silk-string[0] *(la-ssu wei hsien*[3]*)* of the bow was also called *sheng-hsien*[4,d] and the bow was shaped like a half-moon. The string was stroke using a striking pin in the shape of a hammer *(chhui*[s]*)* ; this caused it to emit a sound like *cheng-cheng*[6], while the vibration of the string within the cotton loosened the knots *(chieh*[7]*)* and opened out the tangles. As a result the cotton became fluffy and light and could be used for wadding in winter garments" *(phang-ao*[&]*)* (Fig. 134), once it had been evened out *(chhing-yiin*[9]*)* and pressed *{yii-thieh*[10]*)*. But wadding was only one use; the fluffy cotton could also be spun. However, before spinning could start, the cotton material had to be scrolled *(tsha*[11]*)*[1] with a roller *(chiian-thing*[I2]*)*[e] either made of bamboo or, as was the case in the Huai River area, of a small sorghum stem *(shu shu hsiao ching*[13]*)}*[1] During this process of scrolling tangles and other adhering parts *(chii chieh*[1]**)*[1] could be straightened out, because this was essential for the manufacture of hollow lap-like slivers *(thiao*[ls]*)* or long hollow lap-shaped slivers *(chhang-thiao*[16]*))* of equal size and weight where each single fibre had to be parallel for spinning.

Before starting the straightening, the cotton fibres *(mien-tshui*[''1']*)*[k] had to be

» JVS, ch. a 1, p. 28b, p. 29a; *NCCS*, ch. 35, p. 23a.
[b] *TKKW*, ch. *shang*, pp. 41b, 43a.
<= *NCCS*, ch. 35, p. 23a; *SIKH*, ch. *hsia*, p. 3b.
a jVS, ch. a 1, p. 29a.
[e] *TKKW*, ch. *shang*, p. 44b.
' *TKKW*, ch. *shang*, p. 41b; *SSTK*, ch. 77, p. 17a, p. 17b; *KCTSCC, op. cit.*, p. 3b.
[8] *NS*, ch. 21, p. 29a; *NCCS*, ch. 35, p. 23b.
n *Ibid.*
i *SIKH*, ch. *hsia*, pp. 6b-7a.
J *TKKW*, ch. *shang*, p. 41b.
[k] *MS*, ch. 21, p. 29a.

[1] 彈弓 [2] 彈棉 [3] 蠟絲爲弦 [4] 繩絃 [5] 椎
[6] 錚錚 [7] 結 [8] 胖襖 [9] 輕勻 [10] 熨貼
[11] 擦 [12] 捲筵 [13] 蓿黍稍莖 [14] 拘節 [15] 條
[16] 長條 [17] 棉毳



Fig. 133. Bowing the cotton (*than-mien*), +1765. *MHT*; our illustration shows a section of the stone-rubbing of +1877, ill. IX.



Fig. 134. A woman filling a jacket with wadding material, Shanghai, *c.* 1905. Wilshusen (1), p. 91.

spread over a small table. Then they were drawn out by hand and straightened by the roller which, in or after Yuan times, was widely replaced by a wooden board with a handle *(mu-pan[1])*.[a] The result were cotton slivers *{mien-thung[2])* as they are called in the *Nung Sku.*[b] Every sliver now had about the same length and weight, was stretched and ready for spinning *(chhien fang[3])*.[c]

Fang Kuan-Chheng,[4] who was governor-general of Chih-li for eighteen years,[d] wrote the *Mien Hua Thu* (Illustrations of Cotton Planting and Manufacture), and presented a copy of it to the emperor Kao-tsung in + 1765.[6] The emperor obviously was delighted and added a poem to each of the sixteen illustrations accompanying the explanations by the author. In response to the emperor's poems, Fang Kuan-chheng composed poems in the same metre. The Chinese court must have had an interest in the development of agriculture at this time,[1] as is documented not only by the many agricultural works and encyclopaedias compiled in the + 18th century, but also by the reprints which were published.[8] Woodcuts of the *Mien Hua Thu,* which was originally a painted album, were made shortly after + 1765, and they were used to produce a reprint of the work with additional notes; this was known as *Skou I Kuang Hsiin* (Instructions on the Customs during the Year), and was published in + 18o8.[h]

To illustrate cotton-spinning on a spindle-wheel we have chosen a rubbing from the *Mien Hua Thu* stone-reliefs, carved in + 1877.[1] Below we give the explanation to the illustration by Fang Kuan-Chheng and the two poems which enrich the text.[3] The explanation mirrors the interest and the soundly based understanding of the governor-general in such matters of daily life.

To construct a (spindle-)wheel for spinning (two) upright posts are taken to harness the wheel and horizontally arranged (pieces of) wood (as bearings) to control the spindle *(thing*)*. The spinner is near to the spindle-wheel *(khuang[6])*. The left hand of the spinner holds the cotton sliver *(mien-thiao[1])*, the right hand turns the driving-wheel. The spindle follows the motion of the driving-belt. (In this way) the yarn is naturally drawn (on to the spindle) as it is in reeling silk. This is called: spinning yarn *(fang-hsien[8])*. After four days of (drawing-out *yiri*)*, spinning a single yarn gives one *chin* [596.82 g], (enough) to supply a weaving (loom) (for one day's work). Combining two or three yarns (into one thread) supplies a (strong) sewing thread *(feng-chih[10])*. The price of the twisted thread is thirty per cent higher than the value of the spun cotton. If

» *TKKW,* ch. *shang,* p. 41b.
[b] JVS, ch. 21, p. 29a.
[c] *Ibid.*
[a] *EC,* pp. 233b-235a.
[e] Wang Yü-Hu (/), p. 231, reprinted and published by Amano *(8),* p. 231; Chhen Tsu-Kuei (/), pp. 87-105; Fuchs (8), pp. 71, 74; Kuhn (1), pp. 103-4; Dietrich (2), figs. 1-8. The work is mentioned in Fuchs (9), no. 129, pp. 70-1.
I Fuchs (8), p. 74.
[8] For example the *Nung Shu, Keng Chih Thu, Shou Shih Thung Khao,* see Kuhn (1), pp. 16-20, 67-71, 97-9.
[II] Fuchs (8), p. 74; Kuhn (1), pp. 103-4; Amano *{8),* p. 244.
[1] One set of the rubbings from the + 1877 stone-reliefs is owned by Burckhardt (1), who published the set with the title *Yu-thi mien-hua-thu.*
[J] For the text, see *SIKH,* ch. 2, pp. 7b-8a, gb-ioa.

[1] 木板 [2] 綿筒 [3] 牽紡 [4] 方觀承 [5] 鋌
[6] 軠 [7] 棉條 [8] 紡綫 [9] 引 [10] 縫紩



Fig. 135. Cotton spinning on the hand-operated spindle-wheel, +1765. *MHT*; our illustration shows a section of the stone-rubbing of +1877, ill. XI. (Copies of a few of the rubbings were given to us by the late Prof. Fuchs in 1974.)

the thread is even and there are no little hairs, the price increases by fifty per cent. In the Wu-sung[1] area (north of Shanghai) it is called *fang-sha*[2], spinning yarn; the wheel is driven by foot and one hand spins three or five yarns (simultaneously in parallel). It is an energy-saving (device).[a]

Emperor Kao-tsung wrote:

> In mutual harmony the yarn is spun as the spindle and wheel rotate,
> The work is like the reeling of silk adding to the technique.
> Hearsay has it that in Wu-sung the skill differs.
> As soon as the wheel is driven the yarns are spun separately.

The poem by Fang Kuan-Chheng runs:

> In the sound of the spinning-wheel, the waterclock drips constantly deep in the night.
> The yarn spins lightly and evenly like silk threads being reeled.

* Many Chinese characters in the text have been translated according to the meaning they **had** in **the** vocabulary of the Chhing author. From the viewpoint of technological terminology, many should have **been** translated differently but such a 'technically correct' translation would have resulted in an incomprehensible text, and the aim here has been to provide clear understanding.

[1] 吳淞 [2] 紡紗

Under the eaves of the thatched house the young bride - praised be the skill of her hands.
Her yarn fetches a price as high as for silk threads.

As already mentioned above, Fang Kuan-Chheng had a tendency to idealise the economic conditions of cotton growing peasants. In reality, a cottage industry must have been widespread, though it was practised only in the countryside where there was a shortage of cotton, and in those cities where cotton had to be obtained on the market by urban spinners.[8-] Individual producers exchanged cotton cloth for cotton yarn, and cotton yarn for raw cotton. No cash payments were involved.[15]

There are many cases reported to support the theory that barter transactions were part of a cottage industry system. Chao Kang has listed several examples.[0]

In the reign period Chhien-lung it is reported that in Phing-hu[1], Chekiang province, every household was busy spinning and weaving. Women often worked by candlelight until midnight, the finished cloth being taken to the market in the morning to be traded for raw cotton? Similar evidence can be quoted from Hai-yen[2], Chekiang province from early Chhing times, where we learn that there was little local production of cotton. Traders brought raw cotton from other districts and sold it there, while every morning the local people took the cloth they had woven or the yarn they had spun to the market. The products were traded for cotton which they used to take home for further spinning and weaving.[6]

(iv) *Reasons for the Invention of the Spindle-wheel in Chou China*

Not only from the context of a technical understanding of spinning and other thread processing techniques, but also from the viewpoint of the spindle-wheel's geographic distribution, it appeared essential to deal extensively with the spindle-wheel. Now, after having discussed the history of the wheel in some detail and having analysed the wide range of its application, we should again take up the account of its origin and proceed to an explanation of the reasons which have led us to think that it was invented in the middle of the Chou period.

We repeat that, in our opinion, three factors indicate that a technological change from the exclusive use of hand-spindles with whorls to the spindle-wheel, must have taken place, either and most probably, in the Warring States period (—463 to —221), or even late in the Spring and Autumn period. These are the dramatic reduction in the number of spindle-whorls which have been found, the considerable increase in silk fabrics using twisted and doubled threads and, lastly, the development of the treadle-operated loom.

A comparison between the number of sites yielding spindle-whorls from Shang,

» Chao (1), pp. 52-5. b Chao (1), p. 53. [c] *Ibid.*, pp. 53-4.
[d] *Phing-Hu-Hsien Chih*, ch. 2, p. 51 ; transi, by Chao (1), p. 54.
[e] *Hai-Yen-Hsien Chih*, ch. 8, p. 9; transi, by Chao (i), p. 54.

[1] 平湖 [2] 海鹽

Chou and Han times reveals that the number excavated in Chou and particularly in Han sites, falls so drastically that traditional spindles could not possibly have played the important role in spinning yarn that they had done in neolithic and Shang times.*

The archaeological evidence for an increase in the number of silk fabrics using twisted and doubled threads during the Warring States period is still rather limited. Only in one important archaeological report analysing silk fabrics excavated in 1957 at Tso-chia-thang[1], Chhang-sha, Hunan province, is information supplied about the twist of thread.[b] None of the other reports from the fifties even mentions the word.[0] Considering that Shang silks show a twist both in warp and weft, it is rather surprising that the technique of twisting should have disappeared in Chou times, though just recently evidence has come to light which confirms that the technique was in use during the early years of the Spring and Autumn period, as may be seen from three or four silk fragments in tabby weave *(chüan[2]),* discovered in 1983 in Kuang-shan^ county in Honan province, in the tomb of Prince Meng* of the State of Huang.[5] The silk threads show a twist of 600 to 1000 turns per metre.[d] We have therefore to assume that other reasons are responsible for the previous gap in information like, for instance, a lack of interest. The cause of this may have been that after Shang times, thread spinning techniques had been established, and Chinese scholars may have thought that Chou silk could offer nothing new, and concentrated their attention on weaving, not on the fibres. Regrettably, there is , yet another reason which is even more important : China seems to lack specialists in the field of textile history, a deficiency that has resulted in unsatisfactory

* See above, ch. (c), (6).

[b] Hsiung Chhuan-Hsin (/), pp. 49-56. It is not possible to discuss the silk fragments excavated at Tso-chia-thang in this context on spinning, for technical reasons, but will have to be done in the context of the various weaves of the Chou dynasty.

[c] Here it is possible to list only a few archaeological reports in which silk finds of the Warring States period are mentioned: Anon. *(11);* monochrome patterned silks, silk tabbies, and silk-padded quilts are mentioned on pp. 63-4 (tomb no. 406), pictured on pis. 31-3; relics of destroyed silk fabrics found and reported from Anon. *{608),* pp. 85-93. I" addition, an embroidered and painted fragment of a silk tabby coverlet and two silks which were pasted on the interior of the outer coffin were reported by Kao Chih-Hsi *{2),* pp. 65-70; monochrome patterned silk, five bands of silk tabby, silk tabby clothing, silk artificial hair, and embroidered silk are reported from Anon. *{684),* PP- 33-5°> [st]i" other finds are recorded in Hsia Nai (5)> P- '5- Silk fragments and a silk tabby banner painted in gold and silver pigments are reported in Ho Chieh-Chün (/), p. 39; Anon. *{602);* Anon. *(674).* Another painting on silk was excavated at Chhen-chia ta-shan, Chhang-sha in 1949. Anon. *{637)* ; in connection with the excavation of the site, see Chang Chung-I (/), pp. 57-61. A carbonised patterned silk fragment and a list of other silks in tabby weave were published by Liu Chhing-Chu, Chhen Kuo-Ying (/), pp. 22-4; silk fragments are also reported in Anon. *{710),* PP- 83-5, pi. 17; Chheng Ying-Lin, Liu Shih-Chung (/), pp. 1-25; the authors also report on silk fragments found, while excellent silks are pictured and described by Chhen Yüeh-Chün, Chang Hsü-Chhiu (/), pp. 9-11, and Anon. *{683),* PP- [-8> silk sashes with openwork patterns in silk strips and other silks are mentioned in the report by Wu Ming-Sheng (/), pp. 59-63; the site report Anon. *{603),* P- 7° informs us about one fragment of silk excavated. Various types of silk belts were found in the tombs no. 20a, 207: Chu Te-Hsi (/), pp. 125-7. There are no technical details given from which it was possible to deduce the structure of the silk threads, but there is some probability that the threads had a twist. The famous Chhu Silk Manuscript is woven from untwisted and probably undyed cultivated silk, see Mailey (1), p. 103.

[A] Anon. *{639),* PP- 3[2]9-30 (G2: F-2, F-3, F-4).

[1] 左家塘 [2] 絹 [3] 光山 [4] 孟 [5] 黃

reports considering the many excavations of recent years.[8.] However, we may conclude that twisting thread was common practice in the Ghou period and must have been widespread in Warring States times, otherwise Han dictionaries would not contain so many definitions of the spindle-wheel and the working steps performed on it.[b]

We come now to the third, and strongest reason indicating a change in spinning technology—the treadle-operated loom. Knowledge about the Shang loom is rather limited, but it may be safe to say that the royal workshops were equipped with horizontal pattern-rod looms *(wen-kan chih-chi[1])* having a wooden framework, heddle-shafts *(tsung[2])*, a cloth-beam *(chiian-chou[3])* and a warp-beam *(sheng*).*[c] It is from this type of horizontal loom *(wo-chi[s])*, that a system of 'draw-cords' *(thi-hua-hsien[6])* which looped the warp-threads *(ching[7])* required for the pattern, may have developed. Such a loom could be called a primitive draw-loom, and one may speculate that it existed in Chou times but not earlier. Only when a pattern needed the warp-threads to be raised and lowered as was required in many of the Chou period silk fabrics, may a treadle-mechanism have been invented.[3] In this connection there is an interesting anecdote in *Lieh Tzu* (The Book of Master Lieh),[e] about the master marksman Chi Chhang[8] who trained his eyes by lying under the loom and observing the raising and lowering of the treadle-operated heddle-shafts *(chhien thing chi nieh[9])*. This clearly indicates that treadle-operated looms existed with at least more than two shafts otherwise the exercise would make no sense at all, because Chi Chhang could have foretold which shaft was to come down next. It is clear, too, that they could be operated very quickly.

Such a loom needed a large number of threads for dressing and for the bobbins of the weft. But before going into details it is worth quoting from the works of historians who have tried to explain the expansion of technology required in moving from a craft in the context of European medieval history to an industry.

[B] The general confusion in Chinese publications on the subject is best documented by the reports **about** the problems in textile technology which the silk fabrics of Ma-wang-tui present in, for example, the twisting of threads. It is only mentioned by Anon. *(60s)*. Anon. (607) does not even mention the twisting technique. But matters get even worse in the monograph Anon. (606") which deals exclusively with technology. On p. 18 the twisting of silk thread is mentioned in a few lines and the illustration which goes with the text depicts quilling, but is labelled spooling silk *(lo-ssu[10])*. It can only be concluded that these Chinese scholars regard research in spinning technology to be unimportant.

[b] This conclusion, which will be discussed below, is not only supported by textual evidence **but** also by the serious and thorough study on silk preparation in ancient China by the late Harold Burnham (5), pp. 54-8. Among others, he also arrived at the conclusion that most probably warp and weft were manufactured in the same way, that is to say, the same quilling-wheels were used to produce the warp- and the weft-threads.

« Kuhn (3), pp. 138-50; Kuhn (8), p. 395. a Kuhn (8), p. 390.

[e] *Lieh Tzu*, ch. 5, p. 22a. It would far exceed the scope of this short footnote to go into the question of whether Lieh Tzu was actually a philosopher or just an invention by Chuang Tzu, a 'person' who himself poses some problems. Here, the same viewpoint is taken as that adopted by Forke (13), vol. 1, pp. 284-90, in accepting that major parts of the work at least are Chou originals. The anecdote itself is attributed to the school of Lieh Tzu, before Han times.

[1] 紋桿織機 [2] 綜 [3] 卷軸 [4] 滕 [5] 卧機
[6] 提花線 [7] 經 [8] 紀昌 [9] 牽挺機躡 [10] 絡絲

The quotations may help us realise the importance of such technological movements, for what was true for the Middle Ages was true also for the second half of the — ist millennium in China. Robert S. Lopez wrote:* 'The pre-industrial rise was content with two simple and inexpensive labor-saving devices, which can neither be dated with precision nor be assigned to a known inventor: a pedal-loom in the place of a hand-loom, and a spinning-wheel in the place of the distaff and spindle.' What did this mean practically? Lynn White Jr explained:[b] 'The spinning-wheel—which, incidentally, offers the first example in Europe of the cord drive, was known in eleventh-century China and appears in the West at Speyer about + 1280. The appearance of the heddle-treadle loom in the + 1190s (perhaps also ultimately from China) had so speeded up the production of common cloth that one weaver could keep several spinners busy providing yarn, and thus spinning had become a relatively more costly part of making textiles. The new spinning-wheel, although it still lacked the flyer (which appears in the + 1480s) and the treadle (which is from the + 1520s), increased yarn production and thus cheapened the common grades of cloth. The fourteenth century therefore saw a vast increase in the consumption of linen in particular....'

To intensify the disproportion between the productivity rate of treadle-looms and the treadle-operated spinning-wheel complete with flyer—which was even more advanced than the Chinese spindle-wheel—we may refer to T. K. Deny and Trevor I.Williams:[0] 'Spinning in contrast with weaving, remained the slowest of the basic textile processes. The only important change after the introduction of the flyer in the later Middle Ages was the treadle-wheel.... The treadle worked from the front legs of the spinning-wheel. When it was pressed down, a loop of cord at the other end operated a connecting-rod and crank which turned the wheel. Two cords could be used, so as to drive the flyer as well as the bobbin on which the thread was wound; alternatively, the yarn itself dragged round the flyer. But it still took from three to five spinners to supply one weaver, a disparity which was increased... by the invention of the flying shuttle in + 1733, so that only five years later Lewis Paul together with John Wyatt, patented a scheme for machine-spinning.' That it took about five spinners to keep one weaver going is also confirmed by Eileen Power.[d]

We can now resume discussion on the Chinese spindle-wheel. Chinese scholars have calculated[6] that in one day a treadle-operated loom for hemp fabrics could produce a length of cloth of about three metres; the yarn required would represent the daily production of thirty to forty spinners with hand-spindles.[f] They have also calculated that the productivity rate with the spindle-wheel was fifteen to twenty times higher than with the hand-spindle. This may have been true

» Lopez (7), pp. 133-4.
[b] White (20), pp. 160-1.
[c] Derry and Williams (i), p. 105.
a Power (1), p. 67.
[e] Anon. *{644)*, P- 6^2-
' *Ibid.*, p. 62. This of course is only the case when weaving the fifteen-sheng fabric (warp threads: weft-threads 28:24/cm).

when the wheel was used in the twisting process,[a] but certainly not in the spinning operation. Anyway this figure is, in fact, of little value because we do not know how it was calculated, nor do we know the type and quality of raw material or the type of spindle (gear ratio) used. It is rather difficult to spin yarn of high and even quality on the hand-operated spindle-wheel because one hand is used to drive the wheel. This type of spinning was not a continuous process. And because the construction of both the wheels and the bearings was unlikely to be perfect, it would have been difficult to achieve the now common frequency of 3500 or more rotations per minute. It would seem, then, that the rate of production on such a wheel when used for spinning was only three times higher than before, if the same standard of quality was required.[b] Further, the device would have been best suited for producing low-twisted yarn of fibres such as ramie; hemp would have been less workable.[0] This assumption is also confirmed by the *Thien Kung Khai Wu* (The Exploitation of the Works of Nature) where we read :[d]

An expert in spinning ramie yarn uses a treadle-operated wheel. One female produces on it an amount (of spun yarn) equal to that (produced) by three hand-spinners.

Only with a treadle-operated wheel turning three or more spindles at once would a rate of production ten- to fifteen-fold higher than before have been achieved, but on present evidence the introduction of this cannot be dated to earlier than the + 10th or + 1 ith century.[e]

Another question to be answered is who in China spun the textile fibres. Judging by illustrations and texts from ancient Greece and from other ancient cultures, it is clear that spinning was performed by women. In the Middle Ages too, it was the women who spun, as may be seen from many illustrations. As Eileen Power has remarked:[1] 'All spinning and silk-making, some of the weaving and a great deal of brewing of medieval England was in the hands of women, and many women followed these trades with a regularity sufficiently professional to earn for themselves the title of spinster, webster, brewster, in official documents such as Poll Taxes of Subsidy Rolls.' She continues a few pages later:* 'The spinning of yarn was entirely in their hands. Does the Wife of Bath not remark that God's gifts to women are "deceit, weeping and spinning"?...The term spinster became synonymous with a single woman; and we still speak of the distaff side of the family when we mean the mother's side.' Traditionally, spinning and weaving were the most important occupations of Chinese women.[h] Pan Chao[1] of the + ist century mentions in her *Nii Chieh*[2] (Lessons for Women)[1] that *fu-kung*[3],

» *Ibid.*, p. 64.
•> Schwarz (2), p. 2138; (5), p. 2165; Linder (1), pp. 56-60.
[0] Fannin (i), p. 64.
[e] See below, p. 215.
1 Ibid., p. 67.
* *TKKW*, ch. *shang*, pp. 44b-45a.
t Power (1), p. 65.
h Chhü Thung-Tsu (2), p. 54.
1 Chhü Thung-Tsu (2), p. 54, n. 13; Swann (2), p. 86; Gulik (8), pp. 98-100.

[1] 班昭 [2] 女誡 [3] 婦功

womanly work, was one of the four basic womanly qualities *(ssu-hsing[1]) ;* a woman should devote herself to spinning *(fang[2]),* splicing *(chi[3]),* preparing wine and serving food to guests." Weaving baskets, cloth and sandals also belonged to her domestic activities.[b] Such an understanding of women's responsibilities fitted well into the pattern of the economic function of the Chinese family as an almost self-contained productive unit;[0] indeed, throughout Chinese history, private production by women played a quantitatively more important role than did the government-run weaving mills which used both female and male labour.

There is good reason to follow the interpretation of Werner Eichhorn who said:[d] 'The textile workshops most probably developed from the tailoring and sewing workrooms attached to the courts of the emperor and the powerful lords, which were recruited or, to put it more precisely conscripted from among the most skilful needlewomen in the entire land... .Many of the ladies of the palace will have owed their position there less to their feminine charms and far more to their specific technical capabilities.'

This is certainly true for the textile workshops of the palaces in various dynasties, but we also know that there were textile workshops producing material for the imperial households which were located outside the palace precincts.[6] So at least a dual system of workshops must have existed.

What is more, such workshops were not confined to the imperial household, but must also have been part of big private households, as we learn for example from the *Hsi Ching Tsa Chi* (Miscellaneous Records of the Western Capital) of the + 6th century:[1]

HoKuang's (second) wife presented to Shun-Yü Yen[4] twenty-four rollsof grape (design) silk brocade and twenty-five rolls of thin silk with a ' scattered flowers ' (inwoven pattern). This latter had come from the (textile workshop in) the home of Chhen Pao-Kuang[5] at Chii-lu. Pao-Kuang's wife handed down the technique. Ho Hsien[6] (the wife of Ho Kuang) invited her to come to the Ho family house and asked her to set it up and operate it. The machine had 120 *nieh*[7] and in 60 days one roll (of patterned silk) worth ten thousand cash was produced.[8]

[1] *Hou Han Shu,* ch. 84, p. 278g.

[b] *Hou Han Shu,* ch. 83, p. 2766, pp. 2792-3. For translated biographies containing episodes on weaving see Englert (1), pp. 177, 248.

[c] Chhü Thung-Tsu (2), pp. 26-7.

[4] Eichhorn (14), p. 196, n. 1. See also Eichhorn (5), pp. 139-40.

[e] The *TKKW,* ch. *shang,* p. 40b informs us that the dragon robes for imperial use in the Ming dynasty were woven in Suchou and Hangchou.

['] *Hsi Ching Tsa Chi,* ch. 1, p. 4a; the text was already translated by Wilbur (1), p. 364.

[8] *Nieh* is most probably the name of a part of the loom which permitted a design of 120 'moves'. It could be understood as mails on leashes with the warp-threads passing through each of them. Such a function would permit us to classify the loom as a draw-loom. Chou Chhi-Chheng interprets *nieh* as treadles. He refers to the term as still used in Szechwan today. (Private correspondence, 10 May 1984.) This problem in terminology will be tackled when we come to the loom and the technology of weaving.

[1] 四行 [2] 紡 [3] 績 [4] 淳予衍 [5] 陳寶光 [6] 霍顯 [7] 鑷

But even richer than Ho Kuang, who was practically the 'king-maker' after — 86, was Chang An-Shih[1], about whose household we are told:[a]

(Chang) An-Shih, although he had been honoured as a minister and marquis and had a fief of ten thousand households, dressed in thick black silk, and his wife herself span and spliced (the yarn) *(fu-jen tzu fang-chi[2]).* His seven hundred household serving-lads *(chia-thung[3])* were all skilled in handicrafts and engaged in such works. At home he managed his estate, piling up the smallest things, and therefore was able to increase his wealth and was richer than the commander-in-chief (Ho) Kuang. The Son of Heaven (emperor Hsiian) was afraid of the commander-in-chief and deeply honoured him, but he was really much more fond of (Chang) An-Shih.

It was not only within the aristocracy that self-supporting households existed, for even in the lower ranks daily life must have been based to a large extent on such a concept, which was itself founded on economic necessity.* Indeed, in another account it is said that the wife of Chiang Shih[4] was very sincere and obedient, and that she 'spun day and night *(chouyeh fang-chi[5])* ' to make a living, as may be expected considering her less than affluent situation.[0]

On the basis of Han and pre-Han sources'[1] we must conclude that the spindle-wheel and the treadle-operated loom were invented within the circle of women workers, for they alone would have had both the working experience and technical skill required to see which alterations were necessary and practicable. In the Sung dynasty the women were also in charge of silk-reeling, and it was evidently they who stimulated improvements in the silk-reeling frame.[e]

It is rather difficult to trace the geographical region within China where the spindle-wheel may have developed, but a few words may be said about it. Some of the most important Han stone-reliefs showing textile spinning and weaving technology have been excavated in Theng-hsien[6], Shantung province, which during the Warring States period belonged to the states of Chhi[7] and Lu[8], and where the city of Lin-tzu[9] was a main trading centre. This area was traditionally famous for its silk from wild silkworms, and for its silk fabrics and hemp clothing, as well as for its dyeing industry.[1] The stone-reliefs and the long history of silk production both suggest this may have been the area where the spindle-wheel originated. From Shantung province it would certainly have spread rapidly to Kiangsu and to other regions of China.

[8] *Han Shu,* ch. 59, p. 2652. The text has already been translated by Wilbur (i), p. 365; our Vol. 4, pt. a above, p. 26 and by Chhü Thung-Tsu (2), pp. 355-6.

[b] Chhü Thung-Tsu (2), p. 260.

[0] For the whole story, see Chhü Thung-Tsu (2), pp. 285-6; original source *Hou Han Shu,* ch. 84, p. 2783.

[d] Karlgren (14), pp. 69, 88, 131,2375/.16¾ (+ 1878 edition), ch.5, p. 81 ; *Lieh Tzu* (The Book of Master Lieh), ch. 5, p. 22; Kuo Mo-Jo *et al. (15),* vol. 2, pp. 1071, 1076, 1176, 1187, 1251 ; Maverick (2), pp. 65, 123-4, [!]5[8]> [16]3> [18]7-8; Swann (1), pp. 124, 129, 339; Wilbur (1), p. 365. See also *KCTSCC, (khao-kung-tien),* ch. 218.

e Kuhn ^ p g[4]

' Hsü Cho-Yün (3), pp. 119-22.

[1] 張安世 [2] 夫人自紡績 [3] 家僮 [4] 姜詩 [5] 晝夜紡績
[6] 滕縣 [7] 齊 [8] 魯 [9] 臨淄

(2) TEXTUAL EVIDENCE FOR THE SPINDLE-WHEEL, SPINNING TECHNIQUES AND AUXILIARY SPINNING DEVICES

In following the sequence of tasks performed in silk making one starts with the reeling of silk *sao ssu*[Ia] or *chih ssu*[z.h]. These terms go back to Han times, and to the year — 718 respectively.[0] Reeling was followed by spooling.[4] The most widely known Chinese character for this process is /o[3], a character which is still in use today and has the same meaning. In Han times we find it mentioned in the *Fang Ten* (Dictionary of Local Expressions) of about — 15, where its equivalent in the dialect of Ho-chi* region is defined as *ko*[5],[e] this evidently represents the spooling-frame and not the character for the act of spooling. Apart from /o[6], there are a number of other Chinese characters understood to mean spooling, such as the Han regional terms *chi*[7] and *thai*[8]* as well as others like *thiao ssu*[9],[g] *chieh ssu*[10]* and *phao ssu*[11].[1] As early as Han times, two types of spooling-reels were distinguished: one was named *lo-chhe*[12] or *chi-chhe*[13] and defined as 'the spooling-reel is a revolving reel' *(chuan-huo chi-chhe y eh*[14]*)* j It was therefore used as a 'rotating reel'. The second was the hand-reel for winding silk («a-Aao[15])* (Fig. 136). This was usually four-sided, known as a device for spooling silk *(lo-ssu chu*[16]*)* and was used in 'throwing'. The difference between the two techniques, also reflected in the terminology, will become clearer when we look at definitions of the hand-reel.

The *Fang Ten*[1] quoted in the *Nung Shu* calls the hand-reel [l]*yilan*[n], a character which is mostly used as a verb meaning to hold, to draw, to pull, and indicating here that the silk thread is continuously drawn or pulled from the spooling-frame so that it can be wound round the hand-reel. Obviously by Yuan times the character *yüan*[11] was the one that could be better comprehended than

.* For interpretations of the 'silk-reeling' pictograph in Shang times, see below, ch. *(/),* (2), (ii).

[6] *SWCT,* ch. 13 *shang,* p. ia.

[c] Couvreur (1), vol. 1, p. 26. The *Tso Chuan* (Master Tso's Tradition) was compiled between —430 and —250.

[a] For more information about silk-reeling and its history, see ch. *(g),* (5).

[e] *Fang Ten,* ch. 5, p. 6a; *NS,* ch. 21, p. :6b.

['] *TSTP,* ch. 11, p. 37b; as source for the character *thai* the *Fang Ten* is quoted, *Fang Ten,* ch. 5, p. 6a.

[g] *TKKW,* ch. *shang,* p. 31a.

["] *PFKI,* ch. *hsia,* p. 5b.

[1] *TSTP,* ch. 5, pp. 2b~3a.

[i] *Fang Ten,* ch. 5, p. 6a. Ibid, calls the hand-reel *yuan*[1] .

[k] *NS* (+ 1530 edition), ch. 24, p. ib; the pronunciation given in the *Nung Shu* text below the characters suggest the pronunciation *yu* according to the Chinese *fan-chhieh* system of spelling *(wang*[19] should be regarded as a misprint, it must *heyii*[20]*). Tiieh* is also a possible pronunciation of the character *(CWTTT,* 27425). We have chosen *huo* because it is still in use today.

[1] Wrongly quoted in the Ä (+ 1530 edition), ch. 24, p. lb (see n.j) ; the *Nung Shu* gives ig as well.

[1] 繅絲 [2] 治絲 [3] 絡 [4] 河濟 [5] 格
[6] 絡 [7] 給 [8] 紿 [9] 調絲 [10] 解絲
[11] 拋絲 [12] 絡車 [13] 給車 [14] 轉籗給車也 [15] 絲籗
[16] 絡絲具 [17] 援 [18] 檮 [19] 王 [20] 玉

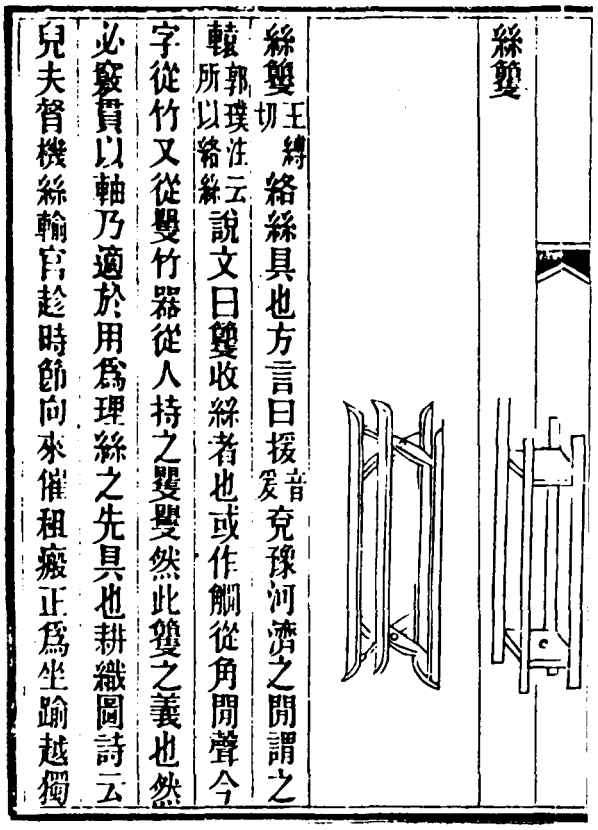


Fig. 136. Hand-reel for spooling silk (*ssu-huo*), +1313. *NS* (+1530 ed.), ch. 24, p. 1ab.

the original given in the *Fang Ten.*[0,] During the Han period its use was limited to the Shantung and Honan regions.

But it is not only a question of a definition which underwent changes; the character *huo*[1] itself changed. In the *Shuo Wen Chieh Tzu* where *huo* is explained as the instrument which takes the silk threads *{huo shou ssu cheyeh*[2]*)*[b] it is written *huo*[3] and so appears without the two eyes. The same is true for *huo* in the *Fang Ten.*[c] Judging from its composition, the character indicates that the reel was made of bamboo and operated by hand in contrast to the *lo-chhe,* which suggests notation representing a wheel-like device. Another character for *huo* wasja[4],[d]

The skein frame or spooling-frame to take the skein was also often called either *lo-tu*[5],[e] *chhe-fu*[6],[1] *ni*[7g] or *chin-ni*[8].[h]*The* term *ni* with this meaning goes back as early

» *Fang Ten,* ch. 5, p. 6a. b *SWCT,* ch. 5 *shang,* p. 3a. [c] *Fang Ten,* ch. 5, p. 6a.
[d] MS (+ 1530 edition), ch. 24, p. ib. After the *CWTTT,* 36004 several pronunciations can be considered such as *yu, yo* or *yao.*
[e] *TKKW,* ch. *shang,* p. 31a. ' *NS,* ch. 21, p. 16b.
[g] *Thing Su Wen* (Commonly Used Synonyms) of + 180 by Fu Chhien, ch. 61, p. 23b.
[h] *NS,* ch. 21, p. 16b.

[1] 簻 [2] 簻收絲者也 [3] 簻 [4] 觸 [5] 絡筦
[6] 車枒 [7] 柅 [8] 金柅

as Han times, the *JVung Shu* explaining *ni* as the 'important part' which is made of hard wood and arranged so as to be movable, while *chin* designates the solid and stationary part of the framework.[a]

Joseph Needham has already discussed the textual evidence of the silk-winding machine (or the throwing-machine for quilling, or twisting and doubling),[b] but it will be useful to summarise his conclusions here. The *Shuo Wen Chieh Tzu* of + 121 defines the *sui-chhe*[1] *asfu-chhe*[2], a (stationary) wheel used for winding silk on to the bobbin in the weaver's shuttle.[0] This meaning of/«[3] is confirmed by Wang Chen's *Nung Shu* of + 1313 which says: 'What receives the weft is the *fu (shou wei yiieh* /K[4])'[d]. Hence it is evident that the *sui-chhe*[5] of old is identical with the weft-machine or quilling-wheel, the *wei-chhe*[6],[e] an apparatus which differs from the spindle-wheel (used in spinning) only in the type of spindle used on it. This consisted of a bamboo spindle *{chu-thung*[1],[f] *thing*[s]*)*[e] which served as axle for the spool or bobbin *(kuan*[9]*)?*[1]

The *Kuang Ta* (Enlargement of the Literary Expositor), a dictionary of dialect synonyms compiled by Chang I between +230 and +232 says:[1] 'The *sui-chhe* is called the *li-lu [sui-chhe wei chih li-lu*[10]*)* ; the *tao-kuei* is called the *lu-chhe [tao-kuei wei chih lu-chhe*[11]*)* '. Needham interpreted the definitions as follows:-[1] 'The silk-winding (machine).. .is also in some places called the 'pulley-machine'. The 'rut-maker' is also in some places called the 'pulley-machine'.' In view of the great antiquity of silk technology in China we may assume that the 'silk-winder' was earlier than the 'pulley-barrow'; the operative wheel most probably acquired its name from the stationary wheel. Meanwhile *li-lu**[2]- is but a variant *oïli-lu*[n], identical in meaning with the most widespread expression for a pulley-wheel, *lu-lu*[14]. And when we turn to the *Fang Ten* (Dictionary of Local Expressions) by Yang Hsiung of - 15 we find that the *sui-chhe* was called *li-lu-chhe*[15] in the regions of Chao and Wei.[k] Needham says that the 'pulley-machine' '. .. had to have at least one pulley, rapidly rotated by the belt from the driving-wheel, follows from the nature of the case... It was the singleness of the shuttle-bobbin pulley (if not indeed of the large driving-wheel itself) which in early times invited the confusion with the wheel-barrow.'[1] The character *chhe* could mean either a stationary machine or a mobile vehicle. Hence it is not surprising to learn that the *Fang Ten* defines the silk-winding

[a] *Ibid.*
[b] Vol. V, pt. 2 above, pp. 266-9.
[0] *SWCT,* ch. 13 *shang,* p. 2a.
[*] *NS,* ch. 21, p. 14b.
[e] JVS, ch. 2i, p. 13b.
[1] *PFKI,* ch. 3, p. 14b.
[s] *TKKW,* ch. *shang,* p. 31b.
[»] *Ibid.*
[1] Quoted from *Kuang Ta Su Cheng,* ch. 7b, p. 30a.
1 Vol. 4, pt. 2, above, p. 266.
[k] *Fang Ten,* ch. 5, p. 3b; *Fang Ten Su Cheng,* ch. 5, p. 10a.
[1] Vol. 4, pt. 2, above, p. 267.

[1] 縼車 [2] 箄車 [3] 箄 [4] 受緯曰孛 [5] 縼車
[6] 緯車 [7] 竹筒 [8] 梃 [9] 管
[10] 縼車謂之麻鹿 [11] 道軌謂之鹿車 [12] 麻鹿 [13] 厤鹿
[14] 轆轤 [15] 轣轆車

machine as 'trace-maker' *(tao-kuei[1]).*[a] Here again we want to quote Needham who has already discussed the analogy:[1]» 'In fact the silk fibre being wound on to the bobbin (or the driving-belt endlessly leaving the driving-wheel) was analogised in popular parlance with the track on sand or mud "being wound off" the vehicle wheel, and what these ancient name-coiners really had in mind was simply the geometrical pattern of a circle and a tangent line.'[0]

That the quilling-wheel of Han times was worked by a driving-belt can be concluded not only from technical reasoning and the Han stone-reliefs, but also from textual sources. The *Fang Yen* explains* that the cord *[chih[2])* underneath the machine is called .. *.pi[3],* while the thicker or longer ones are called *chi[4].* About + 300 the commentator Kuo Pho added that the definitions refer to the *lu-chhe[5],* the silk-winding machine.[6]

The term *yao-chhe[6]* which appears for the first time in the *Thien Kung Khai Wu* of + 1637, and was used exclusively to mean a twisting-wheel for silk threads,[1] appears to have been widely known in Chhing times. It gained importance as the name to designate the multiple silk-twisting frame for warp-threads *{fang-yao ching-cnne[7])*[e] in 19th century China.[h]

(3) DATING THE INVENTION OF THE TREADLE-OPERATED MULTIPLE SPINDLE-WHEEL

Before analysing the structure, function and use of the multiple spindle-wheel, we should have a framework into which to fit the 'invention'. Apart from the hand-operated spindle-wheels of the Han period, there is one Eastern Han stone-relief from northern Kiangsu which gives evidence of a treadle-operated spindle-wheel (Fig. 137). From a stone-rubbing of this, though no conclusion can be drawn on the problem of whether the wheel was equipped with one spindle or several,[1] nevertheless the later Han dynasty can be taken as a safe date for the existence of the device. Unfortunately, the problem of establishing a reliable date for the invention of the multiple spindle-wheel appears to be more difficult for various reasons. While the earliest pictorial evidence dates from the Sung, archaeologically no trace has come to light and there is no descriptive text at all until Yuan times. Yet from what is known of fibre processing techniques, its invention could have

[a] *Fang Ten,* ch. 5, p. 3b; *Fang Ten Su Cheng,* ch. 5, p. 10a, the *Tii Phien* adds *kuei-chhe[s],* see Vol. 4, pt. 2, p. 267 (f). •> Vol. 4, pt. 2, above, p. 267.

[0] *Ibid.,* cf. the colloquialisms of transport: 'filer vite', 'spinning along'; and the 'march' of events: se dérouler.

* Quoted from *Fang Ten Su Cheng,* ch. 9, p. 3b.

[e] For more references on the belt-drive, see Vol. 4, pt, 2, p. 268.

1 *TKKW,* ch. *shang,* p. 31b.

[8] *TSTP,* ch. 5, pp. I2a-I5b; ch. u, pp. 4ia-42a.

[h] For more details, see ch. *(g),* (6).

[1] Anon. (749), p. 76. Huang Kuo-Liang (1), p. 186, fig. 2.

[1] 道軌 [2] 鉄 [3] 畢 [4] 綦 [5] 鹿車
[6] 搖車 [7] 紡搖經車 [8] 軌車

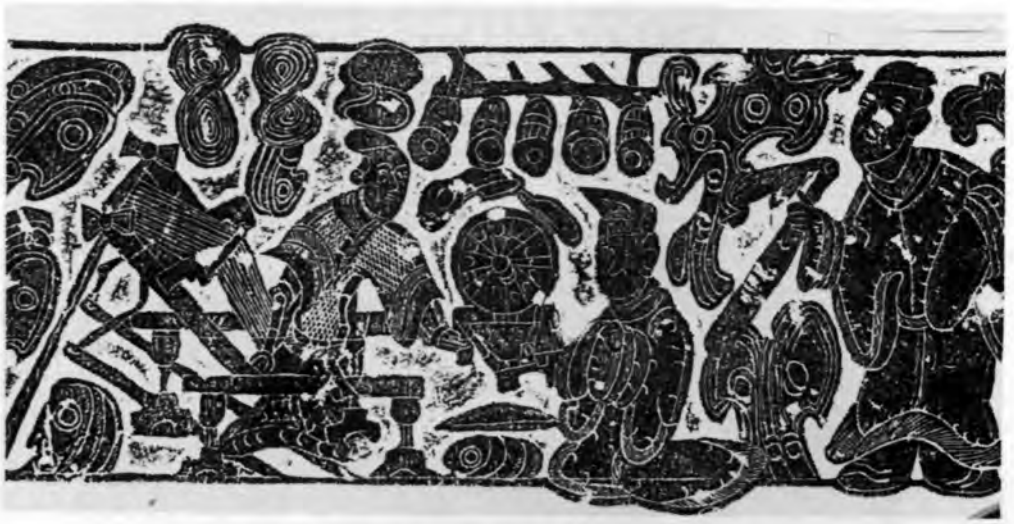




Fig. 137. Treadle-operated spindle-wheel, Ssu-hung-hsien, Kiangsu province, Eastern Han dynasty. For details of the picture see Anon. (*749*), p. 76. (We are very grateful to Mr Kao Han-Yü, Shanghai, for sending us good photographs of the stone-rubbing.)



Fig. 138. Multiple spindle-wheel, reprinted from the *Hsin Pien Ku Lieh Nü Chuan* edition of +1214, based on an illustration by Ku Khai-Chih (*c.* +344 to *c.* +406). Chao Chheng-Tse (*1*), p. 31, fig. 2.

occurred several centuries before the Sung for, as we shall see later, its development was neither connected with silk production nor with the rapid spread of cotton during the Southern Sung and Yuan dynasties.

In publications by Chinese historians of textiles and textile technology, two opinions prevail at present. Kao Han-Yü and Shih Pai-Khuei[a] base the date of the invention of the treadle-operated spindle-wheel with three spindles, *chiao-tha san-tingfang-chhe* [1], on a handscroll by Ku Khai-Chih[2] (c. + 344 to *c.* + 406) of the Eastern Chin dynasty. Regrettably, the *Lieh Nu Thu*[3] (Pictures of Famous Women) in the Palace Museum, Peking, is not by Ku Khai-Chih but is a copy—made in his particular style—by an anonymous artist from the Sung.[b]

Fortunately, though, there is another work of art which we can consider so as to establish a link with Ku Khai-Chih. This is the *Ku Lieh Nu Chuan*[4] (Biographies of Famous Women of Ancient China) which he is said to have illustrated, and whose authorship is generally attributed to Liu Hsiang[5] (—79 to —8). In + 1825 JuanFu[6] (fifth son of the famous scholar Juan Yuan[7]) published the entire book with the illustrations traced by his talented sister Chi-lan[8]; he based the text and the illustrations on a Southern Sung edition (formerly in the Ming Imperial Library).[0] This edition comprised eight *chiian* with two prefaces from + 1063, a

* Kao Han-Yü, Shih Pai-Khuei (*/*), p. 634.

[b] Laing (1), p. 44; Cahill (1), p. 12.

[0] Wu (1), pp. 1218-20; a short remark about the illustrations in the book can also be found in Anon. *{644)*, P- 66.

[1] 腳踏三錠紡車 [2] 顧愷之 [3] 列女圖 [4] 古列女傳 [5] 劉向
[6] 阮福 [7] 阮元 [8] 季蘭



Fig. 139. Multiple spindle-wheel for cotton spinning, *c.* +1868. Goodrich & Cameron (1), p. 67; photography by John Thomson, *c.* +1868.

prefatory note by Tshai Chi[1] from +1062 and a seal indicating the printing house of the Yii[2] family in Chien-an[3] (Fukien), which enjoyed a reputation as a printing centre in Southern Sung and Yuan times. Though there is **only** little doubt that the Sung illustrations were copied from earlier sources based on illustrations by Ku Khai-Chih, not very much of the original artistic flavour seems to have survived.[a] The Chinese scholar Li Chhung-Chou refers to another original Sung source,[b] the edition of the *Hsin Pien Ku Lieh Nil Chuan* (Newly Compiled Biographies of Famous Women in Ancient China) published in + 1214 by the Yii family printing house (Fig. 138) and based on the *Ku Lieh Nu Chuan.*

In many Chinese articles and books the invention of devices for processing cotton very often include the treadle-operated multiple spindle-wheel (Fig. 139),

* One copy of the edition is preserved in the Library of Congress, Washington D.C.

[6] Unfortunately this edition has not been examined personally, but there are textual **and pictorial** references to it, for example, Li Chhung-Chou *(3),* pp. 74-5, fig. 3, **n. 10. The illustration is reproduced** best in Chao Chheng-Tse *(1),* p. 31, fig. 2.

[1] 蔡襄 [2] 余 [3] 建安

and link it with the name of Huang Tao-Pho[ia] (born *c.* + 1245)^[an] ingenious woman textile technician who is said to have introduced the entire process of cotton growing and manufacture from Hainan Island to the Sung-chiang region. This may have happened either in + 1295 or + 1296. Whether Huang Tao-Pho was a native of Hainan or a person who left her native place Wu-ni-ching[2] in Sung-chiang county (now belonging to the Lung-hua[3] commune, Shanghai county) for Hainan when she was still a girl is uncertain, but there is no doubt that she instructed people in the textile arts before the end of the + 13th century in the area mentioned.

The *Chho Keng Lu* (Talks (at South Village) while the Plough is Resting) of + 1366 by Thao Tsung-I+ already contained a short biography of her.[0] This was to honour and glorify the 'cultural heroine in the textile field' who, it says, developed by her own initiative a formerly poor region into a prosperous cotton growing area which afterwards gained a reputation for its high standard of living. On several occasions 'Shrines to the First Cotton Cultivator Huang Tao-Pho' *{hsien-mien Huang Tao-Pho tzhu*[5]*)*[d] were erected, while the story of her inventiveness which so benefited rural communities still occupies a space in the popular educational books.[6] There is even a nursery rhyme which goes like this:[1]

Huang pho-pho, Huang pho-pho,
teach me to make the yarn,
teach me to make the cloth,
two spindles, two rolls of cloth.[8]

That Huang Tao-Pho lived in the 4-13th century nobody can doubt, but that she invented the treadle-operated multiple spindle-wheel is impossible. There is at present no historic material to support this traditional Chinese legend,[11] and as we have already seen book illustrations of the device go back to + 1214 or even earlier. Furthermore, the existence of the wheel can also be found in a scene on the hand-scroll 'Odes of Pin', traditionally attributed to Ma Ho-Chih (activée. +1140 to + 1190) (Fig. 140). The scroll is most probably of late Sung origin.[1]

[a] Here only the textual evidence is listed: Feng Chia-Sheng (7) ; Li Kuang-Pi, Chhien Chün-Yeh *{1),* pp. 304-13; Yen Chung-Phing *(2),* pp. 8-9; Mao Tso-Pen *(1),* pp. 50-1; Wang Jo-Yü *(2),* p. 32;Shih Hung-Ta *(1),* p. 25; Anon. *(644),* pp. 68-70.

[b] Chang Jun-Sheng, Chhen Shih-Chün *(t),* p. 262.

[c] *Chho Keng Lu,* ch. 24, p. 354, see also Goodrich (3), pp. 408-10.

[d] *Swg-Chiang-Fu Chih,* ch. 18, p. 15b; see also Kuhn (1), pp. 24-5. *Hu-Chheng Pei Khao* by Chhu Hua, (early igth century), ch. 1, p. 4b.

[e] For example in: Anon. *{642),* pp. 126-8; Tshai Ching-Feng and Li Hsi-Pi *(1),* pp. 105-10.

['] Chang Jun-Sheng, Chhen Shih-Chün (/), p. 261.

8 The Chinese text reads : *Huang pho-pho, Huang pho-pho, chiao wo sha, Mao wo pu, erh chih thung-tzu, liang phi pu*[6].

[h] YenPhei (/); Chang Chia-Chü *(3);* Wangjo-Yü *(3).*

[1] The handscroll is preserved in the Freer Gallery of Art, Smithsonian Institution, Washington D.C. (negative no. 19. 172-4); Cahill (i),p. 143. There is also some probability that the scroll may belong to the Li Kung-Lin school, perhaps late Sung (+ 13th century).

[1] 黃道婆 [2] 烏泥涇 [3] 龍華 [4] 陶宗儀 [5] 先棉黃道婆祠
[6] 黃婆婆，黃婆婆，教我紗，教我布，二只箇子兩匹布。



Fig. 140. Spinning bast fibres on the multiple spindle spindle-wheel, section from the 'Eight Illustrations to the Odes of Pin', a handscroll attributed to Ma Ho-Chih (active *c.* +1140 to +1190) or to the Li Kung-Lin school; perhaps late Sung, +13th century. Freer Gallery of Art, Washington D.C., (19.172, sect. 3).

It seems certain that the time- and labour-saving multiple spindle device developed from an arrangement of two hand-operated spindles *(shouyao ti sui*[1]*)*[&] fixed to the post above the driving-wheel as pictured on the handscroll *Fang Chhe Thu*[1] (Picture of a Spinning-wheel) by Wang Chü-Cheng[3] (active probably in the middle of the + nth century)[b]>[c] (Fig. 141). Apart from the fact that its two spindles are rotated, the structure of the device is familiar.[d] It shows two people performing the task of twisting: a middle aged woman seated on a footstool works the wheel with her right hand while, with her left arm, she holds an infant. At a distance of a few metres an elderly woman is holding two balls of yarn, one in each hand; these are evidently to be wound on to two spindles—arranged parallel in a spindle-bearing—above the driving-wheel. One driving-belt rotates both spindles simultaneously. To judge from the picture, the yarn is given a Z-twist. A spindle-wheel of this type may have served as a basic model for the rope-maker's wheel as used in the Near East and later in Asia Minor and in the Balkans. In central Europe the existence of the three- and four-spindle wheel for making rope is only documented as late as the + 17th century.[e] The slow transfer of technology from

* Li Chhung-Chou (3), p. 73; Chao Chheng-Tse (1), p. 32.

[b] Laing (1), p. 86.

[0] Yao Hsiu *(1),* pp. 3, 44, 57; Hironobu Kohara states that the handscroll should be dated as belonging to the late Ming dynasty, though painted in the tradition of the Sung painter Wang Chü-Cheng. Cahill (1), p. 181 regards it as a good painting of Sung date.

[a] See above, ch. *(d),* (1), (i).

[e] Endrei (1), p. 114.

[1] 手搖的紡車 [2] 紡車圖 [3] 王居正

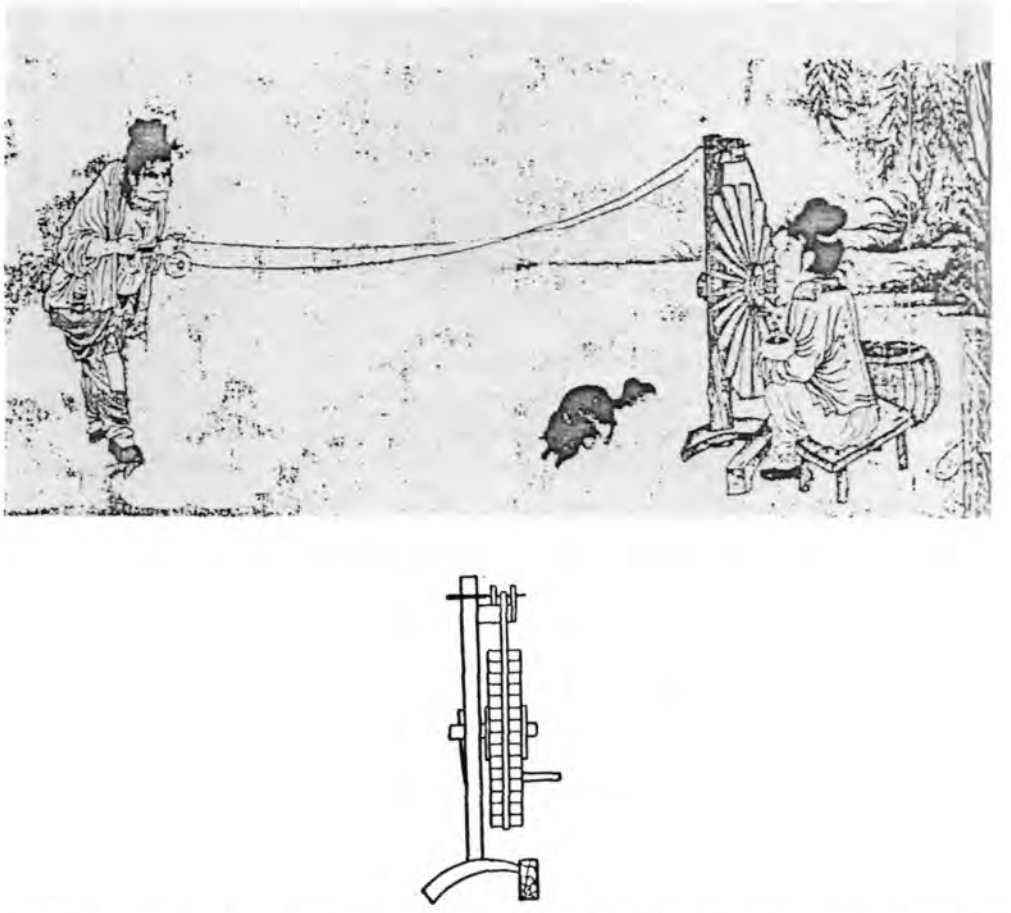


Fig. 141. Spinning bast fibres on the multiple spindle spindle-wheel; handscroll 'Picture of a spinning-wheel' by Wang Chü-Cheng (active in the middle of the + 11th century), probably a copy in the tradition of Wang Chü-Cheng from the late Ming. Ku-kung po-wu-yüan, Peking, reproduced from Yao Hsiu (*1*), p. 3. Diagram of the spindle-wheel of Northern Sung times. Li Chhung-Chou (*3*), p. 75, fig. 6.

East to West indicates that though it originally belonged to the context of bast fibre production, by the time it reached the West its range of use was limited.

When discussing the spinning of waste silk, we saw a picture from Han times[a] showing two people working together at a spindle-wheel. Though the spinning properties of raw silk made it impossible to increase the number of spindles without at the same time employing an equal number of additional operators, the properties of bast fibres favoured such a multiple spindle device. This was because only twisting had to be done to a yarn which had already been spliced *(chi*[1]*)* and wound *{chhan*[2]*)* into balls *(hsien-chhiu*[3]*)* .[b] Before the cultivation of cotton expanded

[a] See above, Fig. 123.

[b] Li Chhung-Chou (5), p. 73.

[1] 績 [2] 團 [3] 綫球

at the end of the Sung dynasty, the multiple spindle device was probably exclusively used for twisting bast fibre yarn, but not for spinning.

As will become evident shortly, it is highly probable that the invention of the multiple spindle, operated either by a crank or treadle and making use of a driving-belt, is to be found in the field of bast fibre processing. Treadle-operated looms with a vertical action for lowering and lifting the heddles are known from Chou and Han times. To judge from previously mentioned sources, treadle-operated spindle-wheels, where the treadle gives rise to a circular motion, may have appeared in Later Han times. But even if they did, there is no necessity for them to have been contemporary with the multiple spindle, or even for the two devices to be connected in any way. And though it can prove nothing, the sequence of available and reliable pictorial material may well indicate the direction of development. Certainly if one looks at it from a technical and historical point of view, it seems to lead to the conclusion that the treadle-operated spindle-wheel is older than the hand-operated double spindle-wheel. This is perhaps to be expected, because the technological presuppositions were given and changing from a hand drive to foot operation allowed one person to perform a task which had previously required at least two people.

Considering that it always took some time before a new technical device became widely accepted and in common use, one may conclude that sometime during the Sung, either in the -I- 10th or in the + nth century would be a safe and verifiable date for the invention of the treadle-operated multiple spindle-wheel as a yarn spinning and twisting machine. From the history of book-illustrations, an earlier date would be acceptable, but pushing its invention back to the +4th or +5th centuries as Chinese historians do appears to be rather risky and not sufficiently supported.

(4) APPLICATION AND FUNCTION OF THE TREADLE-OPERATED MULTIPLE SPINDLE-WHEEL

From Yuan and Ming times many illustrations of the treadle-operated multiple spindle-wheel have come down to us.[a] We shall concentrate on a few only, selecting those which appear to hold a key position in helping to understand the techniques involved. That there are no wheels of this type[b] described and pictured in the context of silk technology should not surprise us, because the device was simply not suitable for silk processing, which focused on high standards of quality

[a] MS, ch. 22, pp. 6a~7a; JVS (+ 1530), ch. 26, pp. 5ab, 7a; *NCSS*, ch. 36, pp. I3ab, 15a; also reproduced in the Chhing compilations: *SSTK*, ch. 78, pp. na-i2b; *KCTSCC, (khao-kung)*, ch. 218, *tshe* 798, p. ib; *STTH, (chhi-yung)*, ch. 9, pp. 4ab; *NS*, ch. 21, pp. 29b-3oa; JVS (+ 1530), ch. 25, pp. 6b~7a; *STTH, {ckhi-yung)*, ch. 9, pp. 42ab; *MCCS*, ch. 35, pp. 24ab; *NS*, ch. 21, pp. 32b-33a; *NS* (+ 1530), ch. 25, pp. gab; *NCCS*, ch. 35, pp. 27ab; also reproduced in the Chhing compilations: *SSTK*, ch. 77, pp. igab; *KCTSCC, (khao-kung)*, ch. 218, *tshe* 7g8, p. 2b.

[b] * There are treadle-operated wheels of course, but no wheels with more than one spindle, see *PFKI*, ch. 3, p. 3b.

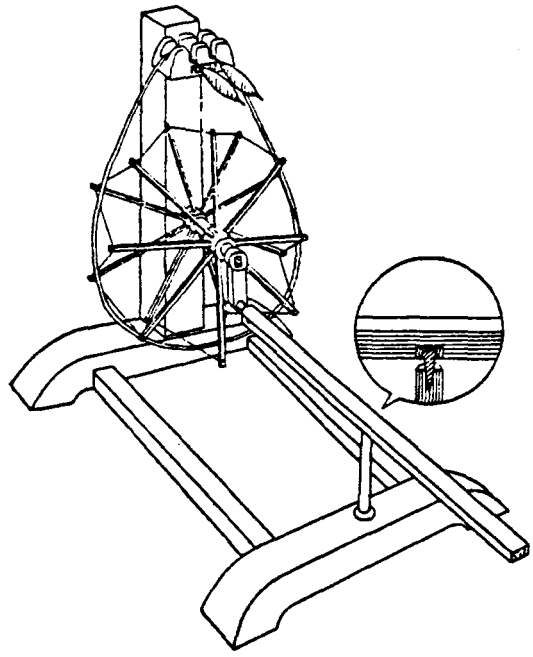


Fig. 142. Treadle-operated multiple spindle-wheel (drawing). Li Chhung-Chou (*3*), p. 75, fig. 8.

and so inevitably relied on continuous quality control. Maintaining the quality of silk meant, therefore, employing the same number of workers as were needed in the traditional way. We can therefore ignore silk production, but do have to distinguish the multiple spindle-wheels used in the processing of bast fibre yarn, especially ramie, and those employed for the spinning of cotton.

From the *Nung Shu* we learn that ' the structure of the (multiple) spindle-wheel for cotton is much smaller than that used for ramie and hemp *(mu-mien fang-chhe chhi chih pi ma chu fang-chhe pho hsiao*[1]*)*'.* Otherwise their structure was similar, though the way they had to be worked differed. But before discussing technical details of its functioning, it is necessary to explain the components of the compound multiple spindle spinning-wheel.

Normally, the head of the treadle driving the wheel was placed directly in one of the spokes near to the axle and not in the crank of the wheel—a survival from the days when the wheel was hand-driven—as pictured by Li Chhung-Chou (Fig. 142).[b] The treadle's weight was balanced on a pin on a quill so that it could be worked easily with the feet (Fig. 143). Although this type of treadle was indeed a labour-saving device, the significance of the device lies in the way the two, three

* *MS,* ch. 21, p. 30a.

[b] Li Chhung-Chou *(3),* p. 75, fig. 8; this type of treadle-wheel composition can only be found on **the** illustration of the cotton yarn doubling-wheel, see *MS,* ch. 21, p. 32b.

[1] 木棉紡車其制比麻苧紡車頗小



Fig. 143. Treadle-operated multiple spindle-wheel for spinning cotton, +1313. *NS* (+1530 ed.), ch. 25, p. 6b.

or five spindles are mounted in their semi-lunar shaped wooden bearing." This wooden bearing consists of two parallel wooden boards of different thickness arranged a short distance from each other; these are held together by square wooden pins. The central square pin—in the case where three spindles are mounted—passes through the boards and fixes the bearing to the post above the driving-wheel. If it was necessary to stabilise the bearing, there may have been an additional support, shaped like a shoulder, for those smaller square pins extending beyond the rear board. Spindles of various lengths, depending on the raw material to be spun, were inserted into the heavier board and rested in open grooves in the lighter board in front. As Hommel has observed, the bearings of the spindles in the heavier boards were lubricated by bits of cloth soaked in oil (Fig. 144).[11] Two

[a] Vol. 4, pt. 2, figs. 402, 403 and 406.

[b] Hommel (1), p. 173.

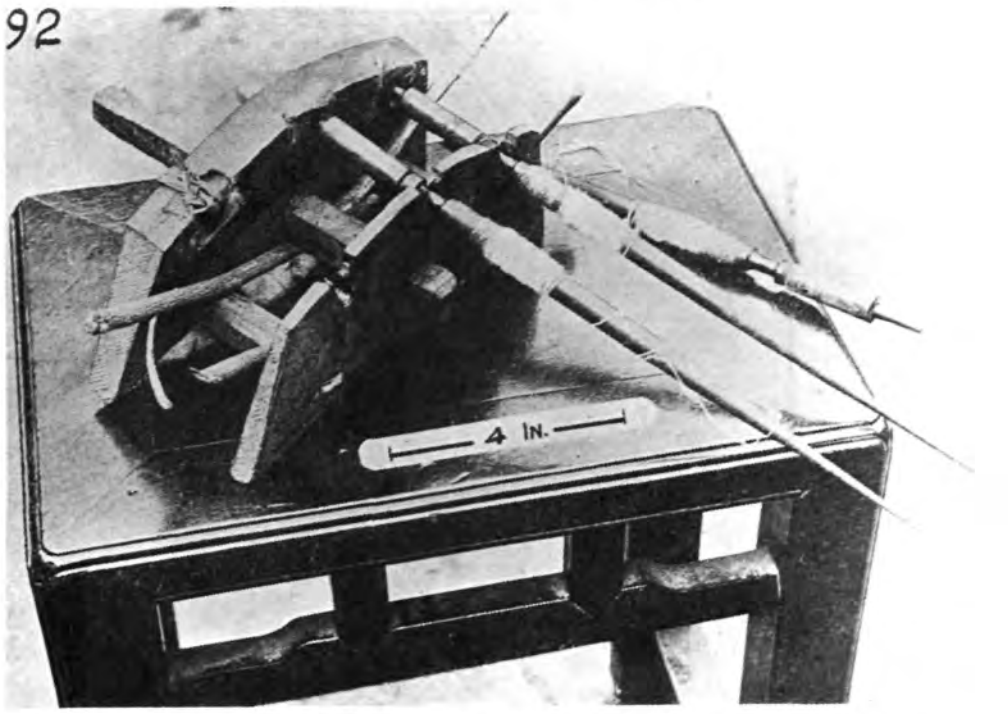


Fig. 144. Spindle bearing of a three-spindle cotton spinning-wheel, 20th century. Hommel (1), p. 176, fig. 225.

sticks with protruding ends were located between the square pins and the central pin (running under the central one and over the pin at each side of it) so as to guide the waxed driving-cord which rotated the spindles. To enable the spindles to make a continuous and even rotation, a tightly fitting bamboo sleeve was fitted over that part of the spindle where friction, and thus the driving action, took place.

The cotton yarn produced in this way had next to be doubled before it could be used in weaving. Obviously this was done with full spindles, otherwise the yarn would have previously needed winding on to small reels. This was an additional process which, judging from the terminology, was never done.

Interestingly enough, Wang Chen calls the spindle, employed in spinning cotton 'spindle for the yarn of the shuttle' *fu-sui*[1,3]. In the description of the big cotton reel frame *(mu-mien khuang-chhuang*[2]*)*,[b] the shape of which Wang Chen compared to an armchair, eight spindles *(sui)* are mentioned. The author explains:[0]

Eight spindles are vertically arranged in a row at the top crossbar of the frame. When the crank is turned, the cotton yarn *(mien-ssu*[3]*)* is drawn downwards and wound on to the reel in parallel strands, separate from each other *(fen* /o[4]).

[a] *NS*, ch. 21, p. 30a.
[b] *NS*, ch. SI, p. 32a; illustration, p. 31b.
[0] *Ibid.*, p. 32a.

[1] 紡紗 [2] 木棉紅床 [3] 綿絲 [4] 分絡

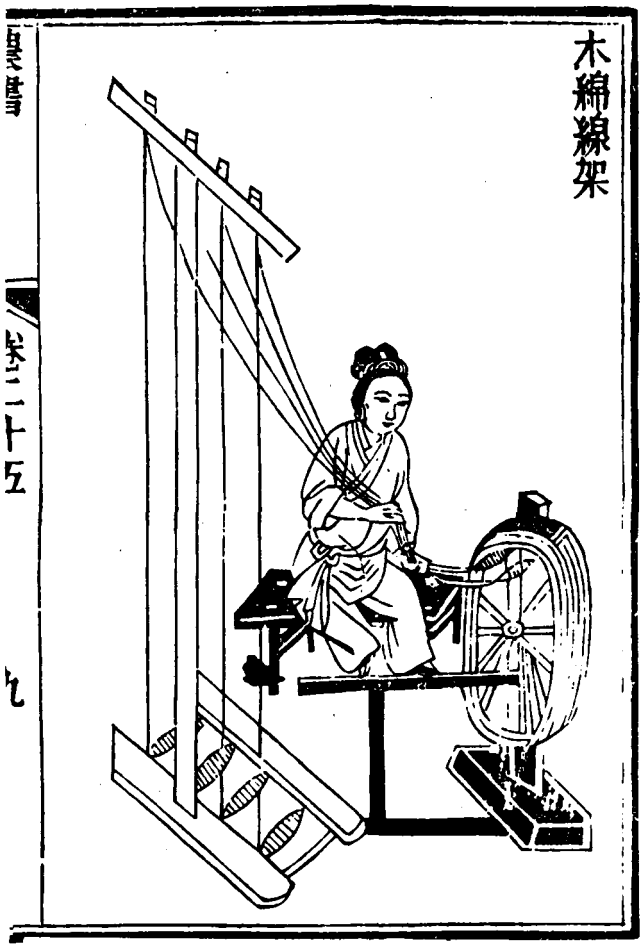


Fig. 145. Treadle-operated multiple spindle-wheel for doubling cotton yarn (*mu-mien hsien-chia*), +1313. *NS* (+1530 ed.), ch. 25, p. 9a.

And he continues:

Compared with the rotary (regulating) wheel[a] *{po-chhe*[1]*)* you obtain eight times as much in one day.

The method was introduced to the north from Fukien province, but in the time of Wang Chen could be found in other regions too.

The cotton yarn frame *(mu-mien hsien-chia*[2]*)* (Fig. i45)[b] used in the process of doubling was square. Between the two long pieces four spindles *(sui)* were arranged

* *NS*, ch. 2i, pp. 3ob~3ia; *NCCS*, ch. 35, pp. 25ab; *SSTK*, ch. 77, pp. 2oab. The *po-chhe* is a device for single yarn winding or as Patterson (1) described it on p. 208: a device for 'hank winding on a rotary wheel'.

» *NS*, ch. 21, pp. 32b-33a; *NCCS*, ch. 35, pp. 27ab; *SSTK*, ch. 77, pp. igab.

[1] 撥車 [2] 木棉線架

in parallel. From these the yarn was drawn upwards through fine bamboo splints bent like hooks and arranged along a crossbar on a pole. Each strand of yarn passed through one hook.

While the two-plyed yarns were wound on to the two spindles driven by the foot-operated wheel, the operator perfected the combining, doubling them by hand.

From all the illustrations, it is evident that the Chinese took advantage of the semi-lunar spindle mounting and used one single driving-cord to work all the spindles inserted in it. Only the 20th century provides us with an illustration of a Szechwanese hand-driven wheel with four spindles, each rotated by a separate driving-cord from the main wheel. With such multiple driving-cords the semi-lunar mounting is unnecessary.[a]

Now knowing the technical differences between the simple spindle-wheel with but a single spindle, and the treadle-operated wheel with multiple spindles, we must turn next to the origin of the latter.

In the main centres of Chinese culture (the central north, the coastal provinces and Szechwan) ramie, hemp and *Pueraria thunbergiana* played a dominant role in plant fibre production until the end of Sung times; then the economic importance of cotton was negligible. This should be kept in mind when considering the origin of the multiple spindle-wheel, because after Sung times the rapid spread of cotton and cotton technology—even to minority regions[1]»—and, at the same time, the reduction in cultivation of bast fibre plants in China, leads one to think that the growth in cotton planting and processing heralded a new age of innovations in textile technology.

It is important to realise that the move to cptton meant simpler processing than had been the case with bast fibres. Nevertheless, technical innovations triggered off by the need for efficient large-scale production, led to a concentration on devices such as the cotton-gin and cotton-bow, which would be suitable for cotton alone, not for bast fibres or for silk. Because of this, the development and adoption of other textile machinery must have followed a different course. Indeed, bast fibre processing techniques of the + ist millennium based on the spindle-wheel used in silk processing, were what provided the basis for the invention of the multiple spindle-wheel, which was certainly to benefit cotton processing after the Sung.[c]

We have already seen that ramie and hemp fibres had to be spliced to give a continuous yarn for spinning, a process which actually involved twisting, because this made it stronger and improved its elasticity. The *Nung Shu* (Book on Agriculture) says:[d]

Before the spinning of the yarn can be perfected, the ramie fibres need to be spliced.

[8] Than Tan-Chhiung *(i),* p. 25; Vol. 4, pt. 2, p. 104, fig. 407.
» Anon. (609), p. 76, fig. 9.
[c] Chao (1), p. 331, n. 15, p. 57.
" *NS* (+ 1530), ch. 26, p. 2a; *pi hsien chi chu ifang chheng lit*[1].

[1] 必先績苎以紡成繘

From one *chin {c.* 600 g) of ramie bast an expert spinner splices one *chin* of yarn.[B] From other sources we learn that

an energetic worker can splice three to four *Hang* (of fibre material) in one working day *[c.* 112 to 150 g]. Even a clumsy worker can splice two *Hang [c.* 75 g] or slightly more.[b]

An expert in spinning ramie yarn uses a treadle-operated wheel. On it one female operative produces an amount (of spun yarn) equal to that (produced) by three hand-spinners.[0]

On a multiple treadle-operated spindle-wheel, *c.* 500 g to 1,500 g could be spun (twisted) in one working day depending on the quality wanted."[1]

The economic advantage of the wheel is evident. The twisting of ramie yarns—which were wound into balls after splicing—could be performed on the multiple spindle-wheel without any problem. There were several reasons for this. The material was strong, the fineness of the yarn had already been determined during the splicing so that it had only to be guided by the fingers of one hand while the other controlled its take-up on to the spindles. It should not surprise us, therefore, that up to five spindles could be operated in parallel at the same time. Originally, feeding was controlled by the right hand, later by a stick acting as a sort of draw-bar to regulate tension of the yarn. Cotton spinning—using short staple fibres to make a continuous yarn—is more difficult than twisting ramie yarns.

An illustration in the *Nung Shu* entitled 'small spinning-wheel' *(hsiao-fang-chhe[1])** (Fig. 146), depicts a female worker drawing the continuous spliced yarn of ramie or hemp through 'guide-eyes'. The yarn is already wound in balls[1] which are placed on the ground. As is evident, the spinner is holding a wooden stick in her right hand; this acts as a sort of draw-bar. The procedure is that she stretches her left arm to draw the yarn away from the machine, and then pushes the stick over to her right-hand side until the yarn ceases to twist and begins to wind round the spindles, which are kept rotating by use of the treadle.

Examining pictorial sources, such as the section from the Odes of Pin (Fig. 140) attributed to Ma Ho-Chih, and the Picture of a Spinning-wheel (Fig. 141) in the tradition of Wang Chü-Cheng we find that they also depict bast fibre being twisted. And there is even reason to accept the suggestion that the illustration in the tradition of Ku Khai-Chih from + 1214 depicts a woman twisting ramie yarn

* *NSCY,* ch. 2, p. 11 a. The text says that from one *chin* of ramie bark one *chin* of yarn can be obtained. This is impossible. Hence ramie bark must be understood as ramie bast.

[b] *Chih Wu Ming Shih Thu Khao Chhang Pien* (An Illustrated Collection of Materials from Various Sources on the Names and Reality of Plants) of + 1870 by Wu Chhi-Chün (repr. Shanghai, 1959), p. 524. In the *TKKW,* ch. *shang,* p. 45a, four to five *Hang* per day are given.

[c] *TKKW,* ch. *shang,* pp. 440-453.

[d] Anon. *(644),* p. 77. [e] *JVS* (+ 1530), ch. 26, pp. 5ab.

' The balls can be considered as a type of roving but cannot be compared with cotton rovings. The fineness of cotton yarn spun from the roving can be regulated by the spinner; the fineness of the ramie yarn is already determined to a high degree by the fibre quality (the working steps of selecting the fibres), and by the fibre-splicing process.

[1] 小紡車

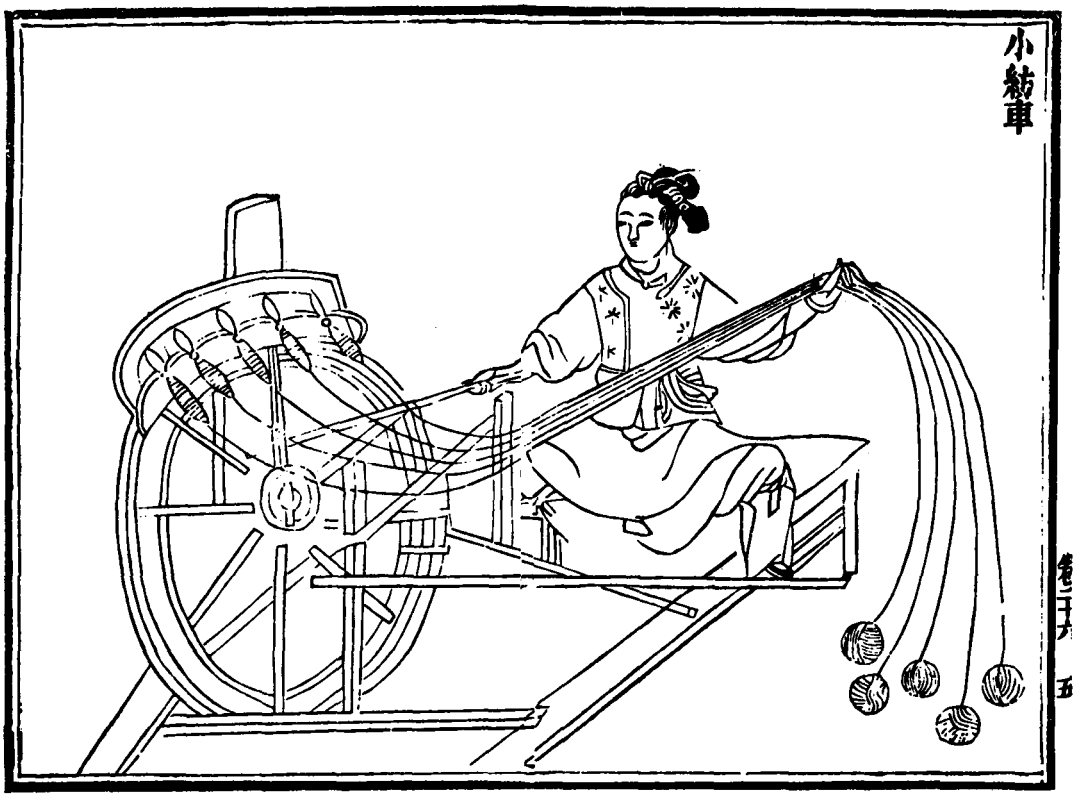


Fig. 146. Treadle-operated multiple spindle-wheel for twisting ramie yarn (*hsiao-fang-chhe*), +1313. *NS* (+1530 ed.), ch. 26, pp. 5ab.

(Fig. 138). Indeed, if one compares pictures of cotton spinning (Fig. 135; Fig. 139) with illustrations of ramie yarn twisting, one instantly realises that all female workers twisting ramie yarn on a treadle-operated wheel work with the left arm stretched out, while all the cotton workers feed the cotton to the spindles from a short distance away. So the illustration from +1214 may rightly be considered as depicting the twisting of ramie yarn.

Having now brought together some arguments based on historical evidence in favour of the theory that the multiple treadle-operated spindle-wheel developed in the context of bast fibre technology, we must continue by adding the most telling evidence in support of this hypothesis.[8a] This is the existence of the large water-powered spinning-frame for ramie and hemp, which marks the high point of Chinese inventiveness and economic productivity in the general development of bast fibre technology. But before explaining this outstanding device, it is desirable to make a few comparisons between Chinese and European techniques of cotton processing, emphasising the economic significance in China of the multiple

[a] Chao also holds the opinion that the cotton technology benefited from the bast fibre and silk technology already at hand; see Chao (1), pp. 57-67.

spindle-wheel. This may help deepen our understanding of the leading role played by the Chinese in the history of textile technology up to about the middle of the + 18th century.

In his excellent study, K. Chao has already analysed[8,] cotton technology in China and compared it with that in Europe, especially Britain. The invention in + 1733 by John Kay (+ 1704 to + 1764 or + 1774) of the flying shuttle demanded a more efficient spinning device to meet the increased demand in yarn, and triggered two other inventions. These were the first spinning-frames, invented in + 1738 by John Wyatt and introduced three years later by Lewis Paul, and the 'spinning-jenny' of James Hargreaves *(c.* + 1740 to + 1778), which he invented some time around +1765 and named after his daughter; he patented it in + 1770. In addition to the Wyatt and Paul spinning-frame, and the improved frame by James Hargreaves, Richard Arkwright (+ 1732 to +1792) patented in + 1767 his spinning-frame with a water-powered drive added (English patents nos. 931 of 3 July +1769 and mi of 16 December +1775), thus initiating the modern factory system. Thus it was that the cotton industry played the leading part in-rtn'e industrial revolution. It all may indeed have started with Arkwright's 'machine', for all the other spinning devices before this should be considered as inventions within the field of craftsmanship but not as evidence of industrial engineering.[b]

However, until the decade between +1760 to +1770 in Britain, the technological standard of Chinese cotton manufacture had no parallel anywhere else in the world. With its treadle-operated three-spindle spinning-wheel as an everyday piece of equipment, three yarns could be spun in parallel,[0] while elsewhere only one yarn could be handled at a time. This was most significant, because as we have seen, cotton spinning is more complicated than spinning bast fibres. The loose cotton has first to be shaped in rovings, and only then can it be spun in a series of well defined steps which include attenuating the cotton filaments by drawing-out; no continuous spinning is possible. In contrast, bast fibre needs no attenuation because continuous yarn is produced during the early stage of splicing. In Britain, an efficient solution to the problem raised by the drawing-out action, formed the key to a new industrial understanding of production.

The use of the Chinese treadle-operated three-spindle wheel for cotton may be considered as a first successful step towards the invention of time- and labour-saving devices, although its further upgrading to a 32 spindle 'machine' did not take place as happened with the multiple spinning-frame for ramie yarn. Driving the spindles by treadle-power, the operator could spin three yarns from three rovings, each of them held between two fingers of the left hand while the fingers of

[a] *Ibid.,* p. 57, p. 68.

[b] For a discussion of the spinning-frames and spinning-machines of the + 18th century, their range of employment, and the socio-economic implications, see Kuby (1).

[c] Chao (1) states that the level of cotton textile technology was out of proportion to China's backward production institution; *ibid.,* p. 57.

the right hand drew the yarn out. An experienced spinner may have even managed to spin four yarns. The right hand served as a forerunner of the draw-bar. Such a spinning system made it possible to produce yarn of even quality and strength. The illustration depicting the twisting of ramie yarns (Fig. 146) depicts a sort of draw-bar in the form of a stick, and such a device could have been used in the spinning of cotton yarn as well after modifying it to suit more spindles than three or four.[a]

The English inventors of the + 18th century searched for similar solutions. John Wyatt and Lewis Paul hoped to be able to control quality and still retain the widest range of fineness by providing the wheel with two pairs of rollers, one pair in front of it and the other behind ; these replaced respectively the right and left hands of the spinner. James Hargreaves' aim was realised in the construction of what was, in effect, a huge mechanical hand to hold a great number of rovings, and fulfil the function of drawing-out in a way that would otherwise have needed the hands of many operatives. He achieved his result quite simply by constructing a horizontal 'draw-bar' to clasp the rovings. This was placed on the top of the machine so that with the right hand working a hand-wheel to operate a belt-drive for rotating sixteen spindles, the operator could use the left hand to move the draw-bar away from the spindles or towards them. When moved away from the spindles, the yarn fed to them was attenuated. Finally, Arkwright ingeniously combined the quality of roller spinning and the use of multiple spindles with a draw-bar driven by water-power. Mass production of cotton yarn was possible for the first time.

We may conclude, then, that Chinese textile technicians had invented all the essential parts of a spinning device for industrial use at least as early as the + 13th century. For more than 450 years Chinese cotton-spinning technology was therefore superior to the spinning methods used in any other country. Indeed, in terms of mechanical structure, even the spinning-jenny, which was never easy to operate, did not match the quality of the big spinning-frame for ramie which will be discussed in the following chapter. The reason why such large spinning-frames were not used in cotton production lies in the Chinese domestic production system, which needed individually operated devices manufactured at low cost. Only when workshops for cotton production were established, especially in the 20th century did such machines become of high practical value.

A few remarks about the rate of output of cotton spinning devices may be helpful. This rate depended on the skill of the spinner, the number of spindles operated and the quality of yarn required. In a working day of 10 to 13 hours, a

[a] Such multiple spindle spinning-frames for cotton yarn came into use during the war (1937-45) when China was cut off from cotton yarn imports and had to rely on her own productivity. The Chinese established handicraft spinning mills and manufactured multiple spindle spinning-frames to cover the demand. Frames with 32 spindles, named *chhi-chhi fang-chhe,* in memory of the outbreak of the war against Japan on 7th of July, 1937, were used in Szechwan and the *yü-yao* type spinning-machine with 64, 72, 84 or 120 spindles came into use in Chekiang province; for more information, see Pheng Tse-I *(1),* pp. 170, 176, 323; Chao (1), p. 69.

Table 3. *Daily Output of Tarn on a Treadle-operated Three-spindle Spinning-wheel**

	Female operator with high skill	Female operator with medium skill	Female operator with low skill
Best yarn	261.10 g	223.80 g	not able
Upper-grade yarn	298.40 g	24245 g	not able
Medium-grade yarn	335-7° g	279-75 g	205.15 g
Low-grade yarn	420.30 g	335-70 g	279-75 g
Average	326.37 g	270.42 g	

female operative could spin four to six *Hang (c.* 149 g to 224 g) on a hand-operated single spindle-wheel? On a three-spindle treadle-operated wheel the daily output could be doubled or tripled (Table 3).

(5) THE WATER-POWERED MULTIPLE SPINNING-FRAME FOR BAST FIBRE YARN

We turn now to the 'big spinning-frame' itself, the culminating point of Chinese bast fibre spinning technology. It was in fact not a spinning-frame in the ordinary sense because it did not carry out all aspects of spinning which include entwining and then drawing out the fibres into a continuous yarn. Its action was purely to 'twist', that is to say put a spiral into yarn or thread,[0] but this it could do to no less than 32 yarns at once. One can argue therefore that the 'machine' should really be called a 'twisting-frame', but because such a device is known today as a 'box spinning machine', the term 'spinning-frame' will be used in this study. It is referred to as a frame because now the word 'machine' usually implies a device powered either by steam or electricity.

In our traditional western understanding of the development of labour-saving devices, the spinning-frames—driven either by hand, animal or water—belong to the front line of inventions marking the beginning of an industrial revolution. But no industrial revolution took place in China. The spinning-frame obviously calls, then, for an economic explanation and several attempts have been made to do this.[d] The authors of the studies agree that the spinning-frame was employed for ramie and hemp, and have tried to analyse the reasons why it was not used for

[a] Shih Hung-Ta (/), p. 35; Yen Chung-Phing *(2),* p. 12; Pheng Tse-I (/), vol. 2, p. 298; Chao (1), p. 70.

t> Pheng Tse-I (/), vol. 3, pp. 682-3; Shih Hung-Ta (/), p. 42: four *Hang* are given as **output rate in** Ming times.

[c] 'Spinning' very often refers to the production of yarns or filaments generally, and includes the tasks of spinning, twisting, doubling etc. Twisting is one of the working steps in spinning. It is in this general sense that spinning is understood by Wang Chen.

[d] Li Chhung-Chou *(2),* pp. 29-30; Liu Hsien-Chou (7), pp. 69-70; Vol. 4, pt. 2, p. 404, pi. CCXLIa; Amano *(13),* pp. 341-68; Elvin (5), pp. 137-72; Elvin (2), pp. 195-8; Chao (1), pp. 56-70; Anon. *(644)* pp. 78-80; Kao Han-Yii, Shih Pai-Khuei (/), pp. 632-44, esp. pp. 635-6.

spinning cotton, taking into account the substantial modifications needed to transform the frame to suit the production of cotton yarn. Yet there is a simple answer to this question; the frame was designed to twist the bast fibres ramie and hemp which are ideally suited to such processing. As we know, the long-staple, uniformly thin, fibres were spliced (connected, *chi*[1]) prior to twisting so as to form a continuous filament. Those spinning processes required for short-staple and loosely connected fibres like cotton, were not needed. In particular, as this spinning-frame could not do the necessary drawing and drafting to produce cotton of a uniform quality comparable to hand-spun yarn, it was never used for cotton production.

To examine details of the big spinning-frame, we shall begin with the material provided by Wang Chen in his *NungSku* of + 1313. This will allow us to attempt a reconstruction of the device and to appreciate the textile technology of which it was part. Thus chapter 20 of the + 1530 edition is devoted to water-powered machinery in general, and here we find an illustration entitled '*shui-chuan ta-fang-chke*'[2], the water-powered big spinning-frame as it was used for hemp and ramie.[8.] The construction of the paddle-wheel does not differ from other vertical undershot water-wheels that revolve on a horizontal axle. In the illustration, the channelled water comes from the right, through a gate by which the flow of the water could be regulated, and drives the paddles of the wheel at the surface of the water. The water disappears in a channel under the workshop.

Wherever there is running water close by in the hemp and ramie producing villages of the Central Plain, many water-powered spinning-frames have been set up. Spinning households of all the other regions imitate the construction. (The machinery) is comparable to the land-based spinning-frame not operated by water but by hand (or by an animal). It is excellent not only (regarding) its convenience (in operating) but also in its economising (effect). All the people profit from it.[b]

Apart from the source of power, the big spinning-frame—worked by hand or by an animal (Fig. 147)—operated in the same way as the water-powered spinning-frame (Fig. 148). The description in the *Nung Shu* says:[0]

The length of the structure measures more than 620 cm, its width about 155 cm. At first the ground frame *(ti fu mu khuang*[3]*)*[i] with upright posts at its four corners, each 155 cm in height, is constructed. (The upright posts are connected by) horizontal bars *(heng-kuang**)* running through them in the middle. Crossbars are placed at' the top of the frame. The crossbars have two grooves *(shan-khous)* to take the iron axle of the long reel around which the threads are wound *(chüan lu*[6]*).* The next step is to set in place a

[a] *MS, ch. \%pp. i&ab; MS* (+ 1530), ch. 20, pp. *lyab; MCCS,* ch. 18, pp. i6a-i7q; other big spinning-frames: *STTH, (chhi-yung),* ch. 9, pp. ßab; *SSTFC,* ch. 78, pp. i2ab.

[b] *MS* (+ 1530), ch. 20, p. 18a.

[c] JVi'.ch. 22,pp.6b-8a;jV5(+i530),ch. 26,pp.6a-7b;JVCC5,ch.36,pp. I4a-i5b;5rr//,ch.g,pp.3ab.

[d] In this context the character/«[7] can be replaced by the character/«[8]; this appears to be more reasonable.

[1] 績 [2] 水轉大紡車 [3] 地拊木框 [4] 橫枕 [5] 山口
[6] 捲纑 [7] 拊 [8] 柎

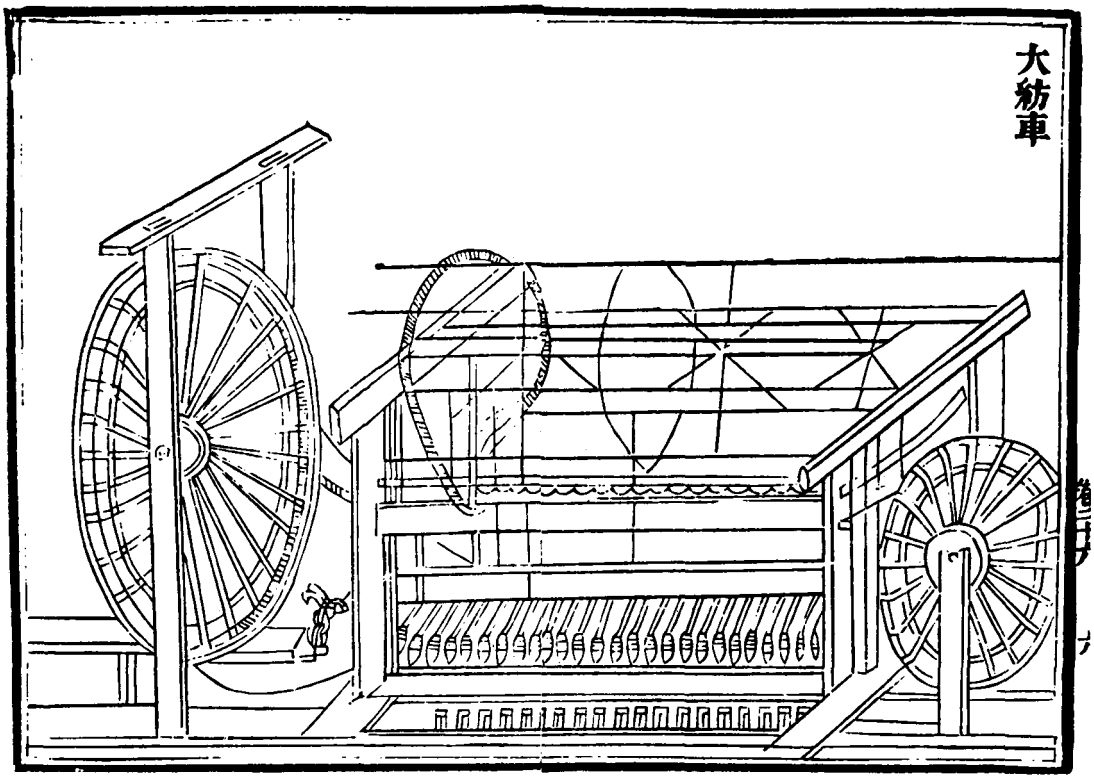


Fig. 147. The 'Big Spinning Wheel' (*ta-fang-chhe*), the multiple spinning-frame for ramie, hand-operated, +1313. *NS* (+1530 ed.), ch. 26, pp. 6ab.

long wooden baseboard *(mu-tso[1])*. On this a row of sockets *(chiu[2])* are arranged at the front ground frame. The sockets hold the iron spindle-shafts *(thieh-hsiin[3])* which are (fixed) to the bottom of the 'yarn-boxes' *(tang[4])*.[8],—These last are round wooden tubes *(thung-tzu[5])*[b] made on a lathe, with a length of *c.* 37 cm and a circumference of *c.* 37 era each. There are 32 of them, containing yarn of joined fibres *(chi[6])* wound in layers *(Man[7])*.—

[8] *Tang* can be replaced by *tang[5]*. Originally it meant 'vertical pegs of wood used to keep the axle-tree of a cart in place'. Here it cannot be understood in this way due to the explanation which follows in the text. This part of the frame, which is a sort of container, is here named 'box'. The reason for this term will be given later. We do not agree with the opinion of Chou Chhi-Cheng and Kao Han-Yu (private correspondence 1o May and 21 June 1984) that the character *tang** could mean a horizontal spindle with a bobbin.

In the text of the *Nung Shu* there is no indication for a horizontal spindle arrangement; all the parallels with silk-twisting frames of later times are valid for the structural parts only, not for the functional parts of the frames. Furthermore, the terminology of silk-twisting frames differs substantially from that used in the case considered here. If the Chinese author of the *Nung Shu* had meant a spindle and a bobbin he would have employed those characters generally used in works dealing with spinning and twisting; there would have been no need for him to introduce 'new' characters to explain their nature and arrangement.

[b] *Thung-tzu* can be replaced by *thung[5]*.

[1] 木座 [2] 臼 [3] 鐵簨 [4] 轎 [5] 筩子
[6] 績 [7] 纏 [8] 轎 [9] 筒

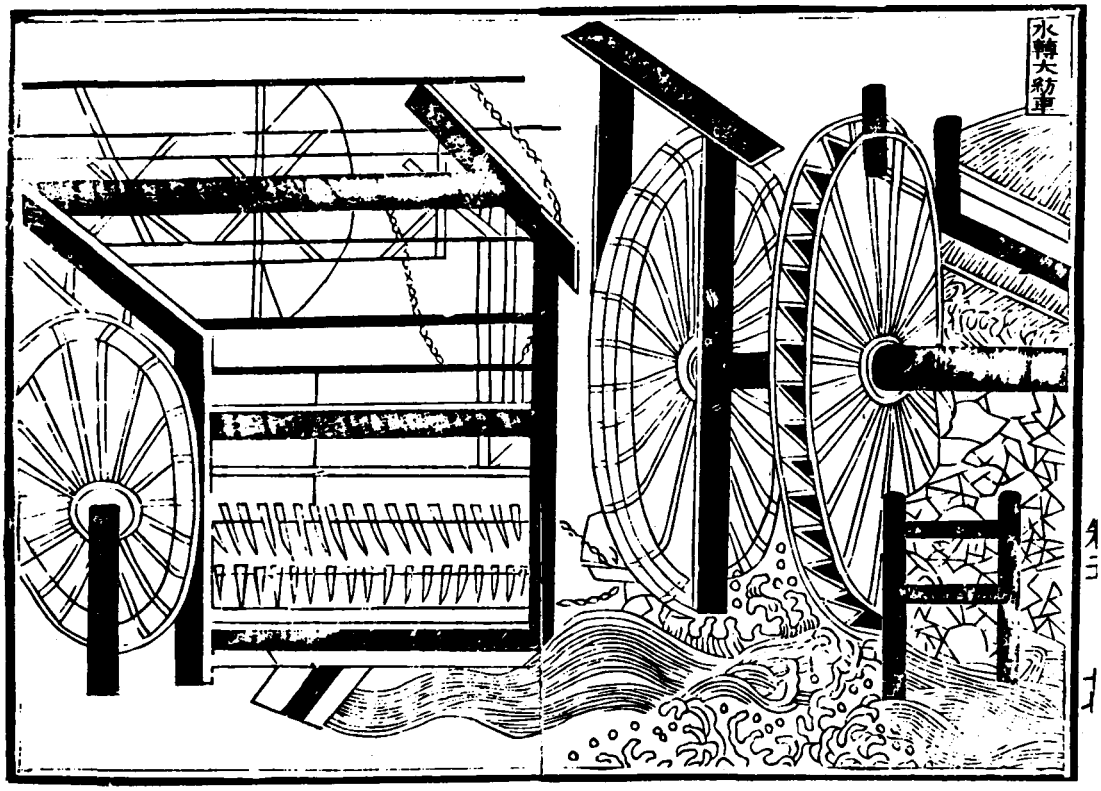


Fig. 148. Water-powered multiple spinning-frame for ramie (*shui-chuan ta-fang-chhe*), +1313. *NS* (+1530 ed.) ch. 30, pp. 17ab.

An iron ring at the end of a strut holds the axle of the box in position at its top. (Between the upright posts) in front of the horizontal bar, small iron forks are arranged in a row (on a ramping-board) seizing (each thread of) 'spur' yarn *(chi-thiao*[1]*)* separately and transmitting it upwards on to the long reel. On the right and left hand sides (of the ground frame) there are two small frames, each with a wheel, joined by a leather driving-belt. On its lower traverse (such a wheel) drives the row of yarn-boxes; on its upper traverse it rotates the revolving pulley *(ku*[2]*)* of the reel.

Either a man or an animal causes the big wheel on the left hand side to revolve (when water-powered the driving-wheel was on the right hand side). The driving-belt (always) follows the motion of the wheel, and all parts of the frame move in accordance with it. The upper and the lower parts respond to each other in a way which depends on the speed. As a result, the 'spun' yarns are tightly wound on the reel. In a day and night (in 24 hours) one can spin 100 *chin* [59.7 kg].

When all households have a lot of (material) ' to spin ', they come together at the driving-wheel. They weigh the spinning material (to be processed) and share (the output of) yarn *(lu*[3]*)* (according to the individual input). (The job) can be completed without effort.

All villages of the Central Plain (in north China) producing hempen cloth use this

[1] 績條 [2] 鼓 [3] 纑

frame. A special illustration with its working method should be sent to the people in other regions. Examining the 'key' to this ingenious mechanism, and copying the construction, can bring about general profit.

A silk spinning-frame *(ssu-hsien fang-chhe[1])* recently set up, differs (only) in details from the one (mentioned) above. Compared with those frames, the framework *(keng-chia[2])* which joins the threads on the open ground[a] is a simplified (version) because of that (difference).

Probably Wang Chen understood by 'closeness' the general construction of the frame and the way it was driven. Furthermore, he could have been thinking of its function, namely, putting a twist into the threads; this was a characteristic common to both frames. Which spinning-frame Wang Chen had in mind cannot be determined because the *Nung Shu* describes no machinery comparable with the multiple spinning-frame for hemp and ramie that could be used for the processing of silk.

The text and the illustrations provide a number of facts which deserve to be discussed (Fig. 149).

1. We can distinguish structural from functional parts.

The wooden framework—the structural body consisting of the ground frame, the posts, horizontal bars and crossbars—had a length of *c.* 620 cm, a width of *c.* 155 cm and a height of *c.* 155 cm.

The functional parts are the driving-wheel,, driving-belts, spindle-shafts and boxes, as well as the iron-forks of the ramping-board and the reel, including its driving-pulley and driving-shafts.

Judging from the illustrations to the text and from the descriptions and pictures of 19th century silk-twisting frames,[0] the driving-wheel of the water-powered type of spinning-frame may have had a diameter of some 200 cm. The frame for this wheel must have been large and strong enough to hold it in position. The wheel at the turning point of the driving-belt, where the driving-belt finished its lower traverse and started its upper one, measured roughly half its size, *c.* 100 cm. All functional parts were worked by a system of three driving-belts, their speeds depending on the velocity of rotation of the big driving-wheel. Because the axle of the driving-wheel served at the same time as the axle of the paddle-wheel, the speed of revolution, being determined by the water flow, could only roughly be controlled by a sluice gate. With the hand-driven wheel, constant speed could easily be maintained, but the water-driven one required far more experience both to build and to regulate. In case of yarn-breakages—which occurred only occasionally due to the natural properties of ramie—the water-powered wheel

[a] Thanks are due to Prof. Phan Chi-Hsing and to Dr. Michael Salt for discussions on the problem of **the** *heng-chia.* In all probability the *heng-chia* should be regarded as a sort of thread twisting device, **perhaps also** used for the manufacture of ropes. See Hommel (1), pp. 179-80.

[b] *TSTP,* ch. 5, pp. I2a-i5b; i6a-igb; ch. 11, pp. 4oab, 42ab.

[1] 絲線紡車 [2] 桁架

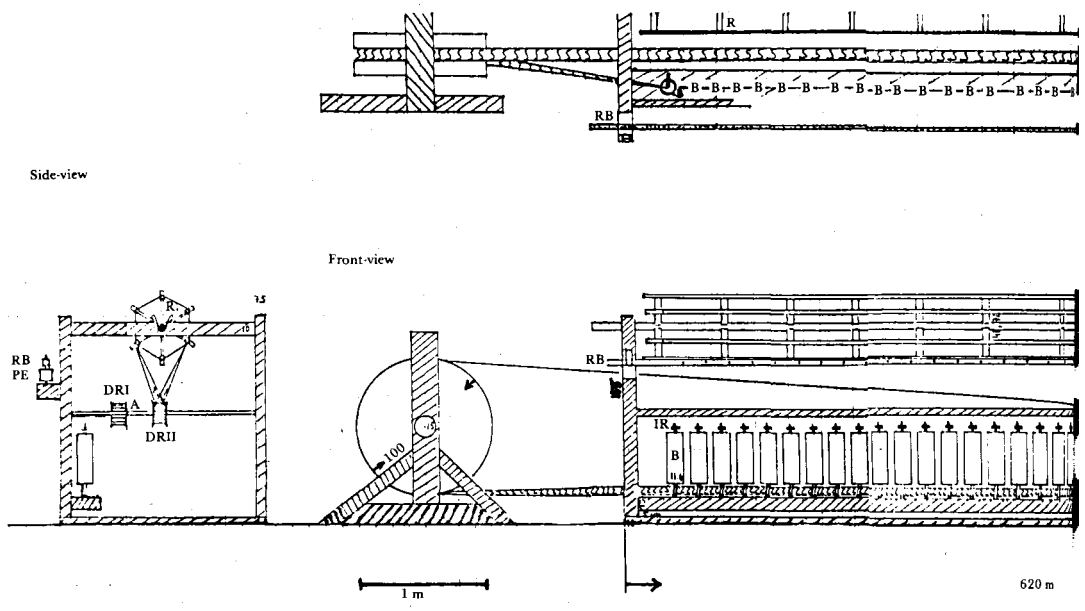


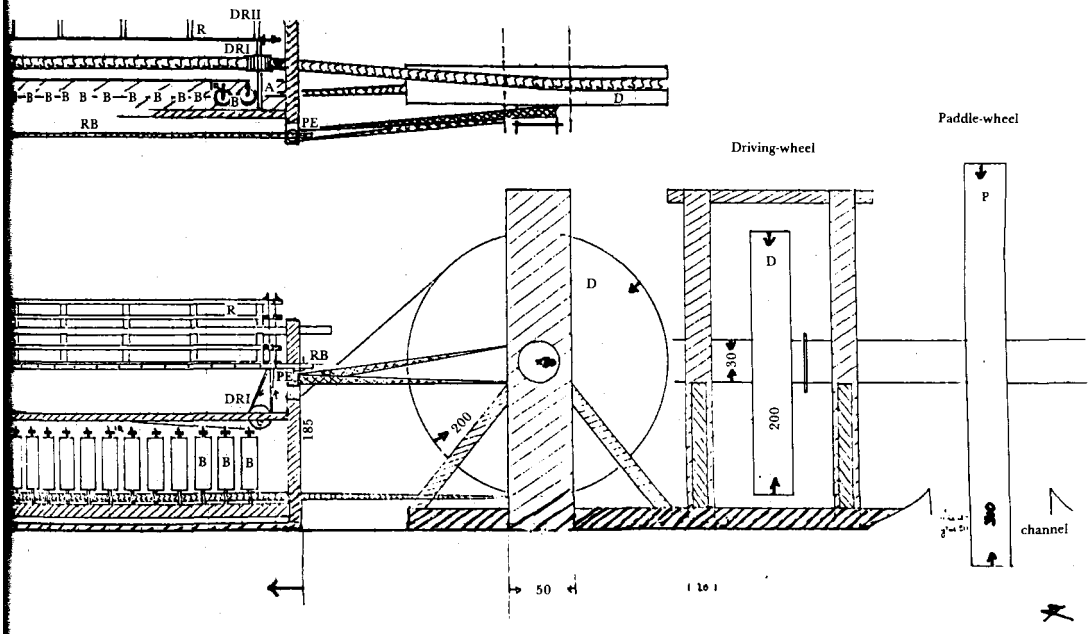
Fig. 149. Reconstruction of the water-powered multiple spinning-frame of +1313. ▨, Wooden framework. ⧖, Driving-belt (upper traverse). ⧖, Driving-belt (lower traverse). ⧖, Driving-belt (pulley). ↑↓, Driving-belt (reel). P, Paddle-wheel. D, Driving-wheel. R, Reel. RB, Ramping-board. PE, Pulley; eccentric lug. B, Cylindrical boxes. S, Spindle-shaft. IR, Iron-ring. DR I, Driving-wheel of A. DR II, Driving-wheel (of the reel). A, Axle of DR I+II.

was probably more difficult to handle than one which was hand-driven; the latter was equipped with a brake-mechanism in the form of a movable board under the wheel. To stop the water-powered wheel, the workmen had to shut the sluice gate. This also had to be done to change the boxes and the reel.

2. There were thirty-two cylindrical wooden boxes, each 37 cm in length and 11.6 cm in diameter, and fixed to the spindle-shafts (Fig. 150). Forming the 'axles' of the boxes, these shafts were held in position above by iron collars mounted on wooden or iron arms. A row of sockets inserted in the spindle baseboard held the iron spindle-shafts underneath.

The material to be spun—the fibres already spliced into an even, thin and continuous yarn—was wound inside the cylindrical boxes in circular layers, starting at the bottom. It was necessary to coil in layers rather than balls, as was the case used with the treadle-operated spindle-wheel, both because layers could easily be unwound, and more material could be placed in the boxes than was possible using balls of yarn.

A few comments on previous reconstructions of the spinning-frame must now be added. One model of such a water-powered spinning-frame has been built, supposedly after the *Nung Shu* description. Preserved in the Li-shih po-wu-kuan,



Peking,[8,] it can only be considered as a general reconstruction of one possible sort of water-powered frame.[b] Certainly it should not be regarded as an exact reconstruction of the one described and depicted in the *Nung Shu,* because it fails on several counts. In the first place, the whole device is too short and contains only seventeen boxes. Secondly, in the *Nung Shu* the reel is driven by a driving-belt, not the axle of the reel as in the model. Thirdly, the driving-wheel is too small compared to the paddle-wheel.

No published description that we have seen of the spinning-frame really tackles the technological implications, though most authors quote from the *Nung Shu.*° The failure is difficult to understand, especially since a similar type of spinning-frame is still operating in the mountainous parts of Chekiang province.*[1]

In his reconstruction of the hemp spinning-frame, Mark Elvin arrived at the conclusion that 'a bobbin carrying the roving is set loosely on the spindle-shaft'.[6] The impression that the frame was equipped with bobbins may have

[a] In November 1982 the frame was not on display but in repair.

•> Liu Hsien-Chou (7), p. 70, fig. 78.

[0] Liu Hsien-Chou (7), pp. 69-70; Anon. *(644),* pp. 76-80, the illustration on p. 79 is based on the model of the Li-shih po-wu-kuan, Peking. The number of boxes appears to be corrected. Li Chhung-Chou (2), pp. 29-30. In his otherwise excellent paper Huang Kuo-Ling *(1),* p. 187, considers the frame to be a twisting-frame with bobbins, but avoids an explanation of the yarn boxes mentioned in the *Nung Shu* text. Indeed, in quoting the text he does not even include this key sentence.

[d] This was explained by Chou Chhi-Chheng in 197g in the Shanghai fang-chih kung-hsüeh-yüan, now the East China Institute of Textile Science and Technology (Tung-hua fang-chih kung-hsüeh-yüan).

[e] Elvin (5), p. 145, fig. 2.

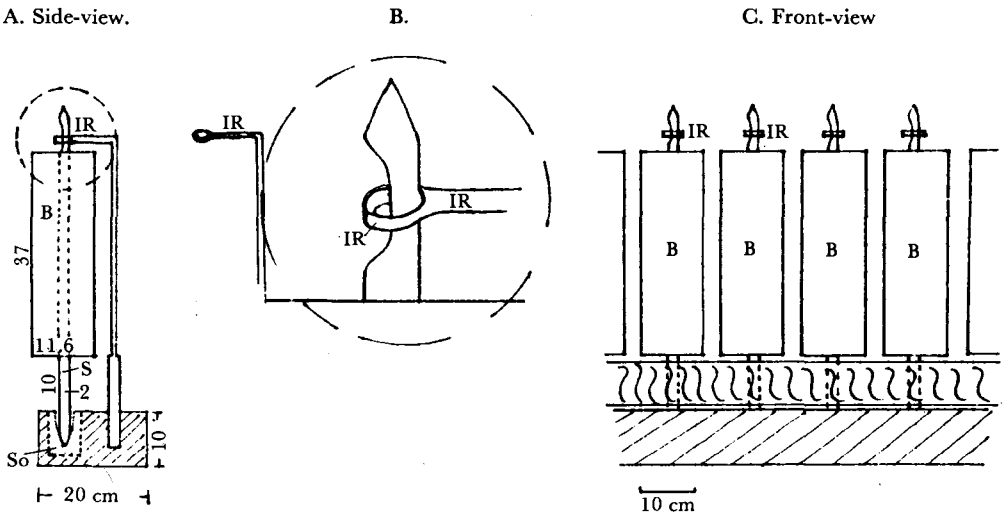


Fig. 150. Reconstruction of the cylindrical boxes of the ancient Chinese 'box-spinning frame'. Based on the text of the *NS* of + 1313. B, Cylindrical boxes. S, Spindle-shaft. IR, Iron-ring. So, Socket.

arisen from various illustrations which show bobbin-shaped yarn-carriers.[a] Obviously the artists misunderstood the function of the yarn-boxes, and commonly drew better known 'shapes' such as bobbins, or simplified the boxes until they became tooth-like objects. That some confusion existed is also evident from the number of yarn-carriers they drew, which varies considerably.[1]* Yet Wang Chen's text clearly states that the 'roving' is inside the box and not wound round it. If there had been a bobbin carrying the roving, the box would have been superfluous. It is not correct to name such boxes 'hollow spindles' or 'bobbin-rollers' as Elvin has done[0] because a very different modern idea of spindle construction is linked to this term. The 'hollow bobbin-roller' simply cannot be compared to the flyer of a modern silk spinning machine.[d] Elvin's bobbin-roller has no intelligible function. The difference in structure and function between the Chinese cylindrical boxes and the European bobbin, which Leonardo da Vinci[e] depicts on a sheet of the *Codex Atlanticus* of about + 1490[1] (Fig. 151), becomes even clearer when one compares his diagram with our reconstruction based on the Chinese text. For him, the belt-driven spindles with bobbins were already to hand, and Leonardo's problem was to find a mechanical means of stopping the rotation of the spindle when a thread broke.

Wang Chen informs us that the upper part (the reel) and the lower parts (the

[a] *MS* (+ 1530), ch. 26, pp. 6ab.
[b] *MS,* (+ 1530), ch. 26, pp. 6ab (26 yarn-carriers); *MS,* ch. 22, p. 6b (12 yarn-carriers); *MS,* (+ 1530), ch. 20, pp. i^ab (17 or 18 yarn-carriers); *MCCS,* ch. 36, pp. I4ab (14 yarn-carriers); *STTH, (chhi-yung),* ch. 9, p. 3a (24 yarn-carriers); *SSTK,* ch. 78, pp. I2ab (13 yarn-carriers).
[c] Elvin, (5), p. 144.
[A] Elvin (5), p. 145; for definition, see *TDD,* p. 42.
[e] Ponting (1), pp. 10-11. ' Pedretti (1), p. 36.

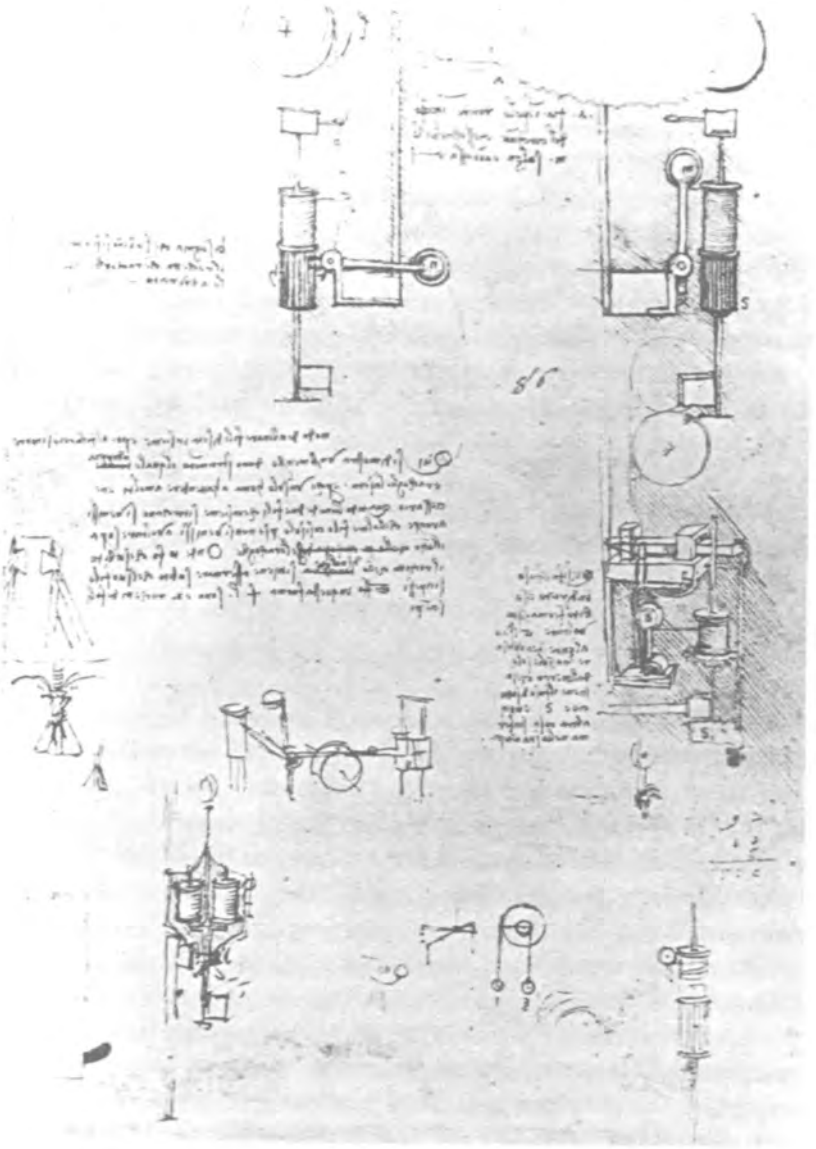


Fig. 151. Diagrams of belt-driven spindles with bobbin by Leonardo da Vinci, *c.* +1490. *Codice Atlantico*, Biblioteca Ambrosiana, Milan, reproduced from Ponting (1), p. 11.

boxes) match each other in speed of rotation. This means in practice that the boxes release roughly the same length of yarn per second as is wound on to the reel. The yarn is twisted by the rotation of the box, and so its length decreases a little. The higher the number of rotations per second the more turns are put into the yarn per cm. This results in negligible drawing-out (stretching) of the yarn; hence the frame does twisting and winding only.

Let us now consider the logistics of the spinning process. In 24 hours, as we

noted above, the spinning-frame produced 59.7 kg of yarn from 32 boxes. If four hours out of 24 hours were enough to replace empty boxes by full ones and to exchange reels with yarn wound around them for empty reels, only ten minutes per hour could be spared for this. If people with on-the-job training were available, so tight a programme might have been feasible, provided the reels and boxes had been prepared beforehand. Regrettably, there are no data available.

Thirty-two boxes (Fig. 150) produced 59.7 kg in 20 hours, or 93 g per box per hour. To calculate the length of yarn spun we need to introduce a measuring unit such as a metric number (Nm) expressed in m/g or km/kg (used in Germany) or the tex-system which was developed by the International Organisation for Standardisation (1 tex = 1 g/iooo m).[a] The length of yarn which had to be spun per hour varied with the desired fineness :

Quantity p.h. : 93 g	m/h	m/min	m/sec
Fineness :			
Nm 5 (tex 200)	465	7-75	0.129
Nm 10 (tex 100)	930	15-5	0.258
Nm 15 (tex 66.6)	1395	23-25	0.387
Nm 20 (tex 50)	i860	31	0.516
Nm 30 (tex 33.3)	2790	46-5	0-775

The yarn had to be 'low-twisted', otherwise the boxes would have revolved too fast and started 'whizzing' (getting out of control). Moreover, the faster the frame worked in terms of metres per hour, the more often boxes and reels had to be changed. In consequence, there was a limit to the fineness which could be achieved ; this had to be below Nm 20, and in practice ranged from Nm 5 to Nm 15.

The direction in which yarn was drawn off was controlled by thread-guides, which were small iron-forks fixed on the ramping-board. By making the ramping-board oscillate, the wound yarn was laid on to the reels in broad bands. We assume that the yarn was drawn upward through the iron-rings, along the axles. At the place where it passed through the iron-ring, the axle had a groove to guide the yarn upwards. Constructed in such a way, the axle, iron-ring, and yarn do not interfere and the yarn can receive its twist; a similar design can be seen in the box spinning machines of the 20th century.[b] The Chinese spinning-frame, therefore, already contained the general idea of such spinning technology in a nutshell.

On its lower traverse the leather driving-belt drove the row of spindle-shafts. It is difficult to imagine that uniform motion was possible without a driving-channel for the belt and a set of counter-rollers to ensure uniform tension. The illustration of the *San Tshai Thu Hui* (Universal Encyclopaedia) of + 1609 gives the impression that there was a driving-channel[0] but we cannot be sure of this. On its upper traverse, on the way back to the driving-wheel, the belt caused a

» *GTL*, vol. 2, pp. 121-2, 469.
[b] *GTL*, vol. 1, p. 290.
[0] *STTH, (chhi-yung),* ch. 9, p. 3a.

driving-shaft to rotate. This rotation was transmitted through the axle to a second driving-shaft, which turned the reel by means of another driving-belt.

The pulley on the ramping-board may have been worked by a driving-belt running round the axle of the driving-wheel, a way of working used in 19th century silk-doubling frames.[a] However, there is at present no direct evidence that spinning-frames from Sung and Yuan times did this.

It is now time to summarise our conclusions about the device. The general structure and the functional parts of the multiple ramie spinning-frame were obviously borrowed from silk machinery. Not only the wooden framework of the multiple silk-twisting frame but also the drive mechanism for the spindle-shafts may have served as models, while the pulley of the eccentric lug oscillating the ramping-board was adopted from the silk-reeling frame. However, as we have seen, the ramie-spinning frame was equipped with cylindrical boxes instead of the bobbins of the silk-twisting frame.

The technical details of its rotary motion and the 'gear-ratio' are very complex, but there can be no doubt that the Yuan spinning-frame is an early predecessor of the box-spinning machine (Dosen- oder Topf-Spinnmaschine) and should really be called a box-spinning frame. As we have seen, it manufactured low-twisted yarn of middle and coarse qualities below Nm 20, which was used for underwear, summer cloth, mosquito-nets and so on. The technical similarity between our spinning-frame and the modern low-twisting machine, used for coarse yarn, including the arm carrying the iron-ring to steady the axle of the cylindrical box, is striking.

The big multiple spinning-frame testifies to the use of money-saving means of production in China. We may suppose that its invention took place in Sung times, for by + 1313 it was already employed in all hemp and ramie growing regions of the Central Plain. The development of the frame and its continuous technical improvement took many years. Indeed, decades, possibly even a complete century, were needed for the dissemination of technical knowledge about the way it had to be constructed and operated.

It would be a mistake to link the frame's invention with the beginning of an 'industrial revolution', for this never took place in China. In European textile production, the industrial revolution started with new cotton manufacturing technology, but the Chinese water-powered multiple spinning-frame could not ba employed for spinning cotton. As we have seen, its technical limitations prevented it from performing the necessary drawing and drafting. The frame's invention must rather be explained, therefore, in the context of rural communities producing hemp and ramie. This is because ramie is a perennial plant, harvested several times a year. Thus with ramie the spinning-frame could be worked all the year round, apart from a few winter months when there was ice on the rivers. So complex a device would not have paid off for hemp alone.

[a] *TSTP*, ch. 11, pp. 4oab, 42ab.

In consequence we must conclude that the spinning-frame had its origin in the countryside; it was built by countryfolk, and used by peasants in their cottage textile industry, though who owned the frames themselves we do not know.[8.] Establishing such frames in a rural setting helped save money which otherwise would have been spent on spinning-wheels, which could not produce economically the qualities for which the frames were suitable. Taking 1000 g of coarse spun yarn as the average output of the multiple-spindle treadle-operated spinning-wheel during a 12-hour working day, then it would have required some 30 spindle-wheels, operated 24 hours, to produce the equivalent amount of c. 60 kg spun by the frame during the same period. Hence money and labour was released for more essential activities than spinning, such as sericulture and agriculture.

It is clear that the spinning-frame was constructed to twist yarn, the only task in the processing of ramie to a coarse and medium standard which was open to labour-saving techniques. It was quite incapable of splicing fibres and turning them into fine yarn. The important working steps of splicing and spinning, the latter including the drawing-out of ramie fibres which had been artificially cut short, still had to be done manually. As to fine quality ramie yarn, this still depended completely on hand spinning. In short, its production was severely limited. Moreover, ramie harvesting and processing^as practised by the Chinese depended upon cheap and plentiful labour, while the spinning-frame itself required many trained people to fill its boxes with yarn and to change them and the reels if it was to work 24 hours a day. Certainly, it replaced many spindle-wheels which had to be driven individually, but its operation was still labour-intensive. With increasing economic emphasis on cotton cultivation since the + 14th century the multiple spinning-frame for bast fibre twisting by and by lost its attraction as a means of production to the farmers and, therefore, its economic importance. After + 1313 no additional information about this frame is supplied in the sources. Only in the 20th century during the war (1937-45) when China was cut off from cotton yarn imports we hear of a technically modified multiple spinning-frame (equipped with spindles) for the spinning of cotton yarn.[b]. The multiple spinning frame of Sung and Yuan times cannot therefore be considered to be an invention which heralded a new age in the production of textile fibres.

[a] On the problem of ownership Mark Elvin in (5), p. 156 writes: **'It would be a plausible supposition that the** majority of hemp-spinning machines, capable of producing **up to 40,000 pounds of yarn a year, were owned** by manor lords or other well-to-do persons who made them **available to the peasantry for a cash fee or a** percentage of the yarn.'

[b] See above, p. 224, n.a.

(e) ROPE-MAKING

... in daytime you shall go and gather the *mao* grass, in the evening you shall make ropes *{chou erhyü mao, hsiao erh so thao[1]).'-*

When discussing the beginnings of hand spinning we looked at the simple methods used; rope-making also has its origins in similar basic techniques. Indeed, the site of Chhien-shan-yang in Wu-hsing, which dates from between — 2850 to — 2650, has yielded not only several fragments of basketry but also ropes made of bamboo[b] and ramie.[0] The coarsest bamboo material used measured 2.5 cm in diameter, but mostly finer qualities were preferred.*[1]

Chinese texts of the — ist millennium provide ample evidence of characters referring to rope, cord and string. But before examining such Chinese references, we should first define what wje mean by a rope. For our purpose, we suggest that cordage with a circumference of 2 cm and more should be called a rope. Twisted material of smaller dimensions may be termed cord and twine, or when very thin referred to as thread and yarn.[e]

Widely known terms for ropes are *skeng[2]* and *so[3]*. In the *Shuo Wen Chieh Tzu* (Analytical Dictionary of Characters) of + 121 *sheng[1]* is defined as *so.* The definition of *so* reads: 'plants have stalks and leaves (out of which) ropes and cords can be made' *(tshaoyu chingyeh kho tso sheng so*).*[g] Many other characters such as mo[5h] and *heng[6i]* are defined as *so; hsiian[ni]* and *chhen[sk]* are explained as being *sheng-ropes* to lead the cattle, *keng[91]* and *chii* (or jä[10])[m] as *sheng* well-ropes, *kang[lln]* as a guiding rope of a net. There were ropes to harness horses to chariots, such as *chih[120]* and *pan[3],[p]* ropes for pulling coffins *po[uq]* or the/a'[5r] used in funeral ceremonies; furthermore there were ropes made of bamboo[8] and many more types.* Indeed,

» Karlgren (14), p. 95, no. 152 (7).
[c] *Ibid.,* pi. 10: 6.
[e] *EB,* vol. 23, p. 713; *GTL,* vol. 2, pp. 367-9. The 'definition' given above cannot be applied for modern rope-making techniques which have other standards of definition.
' *SWCT,* ch. 13 *shang,* p. 10b; *Yü Phien,* ch. *hsia,* p. 46b.
[b] *SWCT,* ch. 13 *shang,* p. 12a; *Yü Phien,* ch. *hsia,* p. 47a.
' *Ibid.*
[I] *Ibid.,* p. 12a; *Yü Phien,* ch. *hsia,* p. 47a.
[II] *Ibid.,* p. 9b.
1 Karlgren (1), 275d.
[8] Bamboo rope *tso"',* Karlgren (1), 806v.
" Anon. *{757),* pi. 10: 1.
[d] Kuhn (9), p. 41.
[g] *SWCT,* ch. 6 *hsia,* p. 2a.
' *SWCT,* ch. 13 *shang,* p. 12a.
[k] *Ibid.,* p. ub.
[m] *SWCT,* ch. 13 *shang,* p. 12a.
[p] *Ibid.,* p. ub.
[r] Fraser and Lockhart (1), no. 2143.
[°] *Ibid.,* p. ub.
' Such as *thiao,*[xl]Karlgren (1), 1099^ *lei'*,* Karlgren(i), 5970; *hut"',* Karlgren(i), 577s; *chien[20],SWCT,* ch. 13 *shang[2'], p.* 1 ia; *hsieh[22],* Fraser and Lockhart (1), 2154; Karlgren (1), 338c; *wei[2'], SWCT,* ch. 13 *shang,* p. 9b;/a[24], Karlgren (1), 49if; *chhen[2i],* Karlgren (i), 372a; *yüeh[lh],* Karlgren (1), 1120m; *chiang[11],* Karlgren (1), 713c; *chui[3]*,* Karlgren (1), 543h; *hung[29],* Karlgren (1), 887h and many more.

[1] 畫爾于茅宵爾索綯 [2] 繩 [3] 索 [4] 艸有聚葉可作繩索
[5] 縲 [6] 絕 [7] 縼 [8] 紛 [9] 緆 [10] 緣
[11] 綱 [12] 縶 [13] 絆 [14] 撥 [15] 紼 [16] 笮
[17] 條 [18] 縲 [19] 徽 [20] 緘 [21] 十 [22] 紲
[23] 維 [24] 紵 [25] 綸 [26] 約 [27] 繩 [28] 縋
[29] 紘

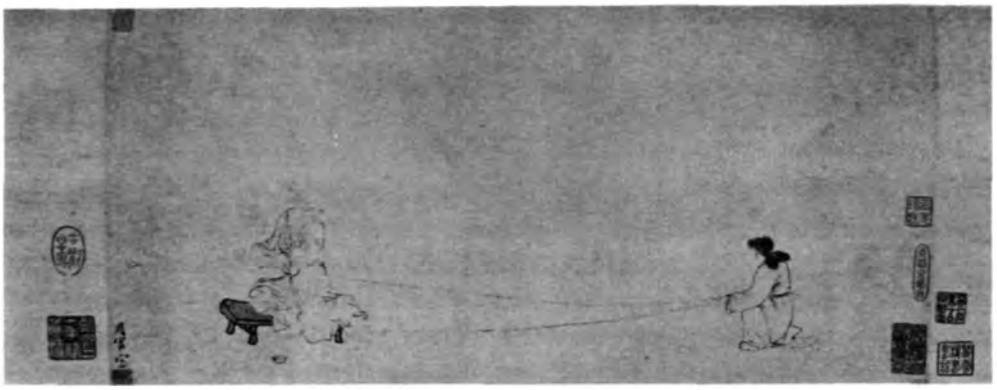


Fig. 152. Rope-making, handscroll by Chou Kuan, second half of the + 15th century. Anon. (*764*), vol. 5.

in China, hemp, ramie, jute, rushes, reeds, bamboo and palm fibres have all been used for rope-making.

The simplest way of producing cord was by hand without any auxiliary devices. Such a technique, where one person holds the two strands, one of them in his hand and the other tied to his big toe, while his companion standing some distance away twists them together, is pictured on a handscroll by Chou Kuan[1] (active about the first half of the + 15th century) (Fig. 152).[8,] Another simple method was used when making bamboo ropes. Two workers on a high wooden structure like a tower, cord bamboo strips which have been cut several metres long and hang down from the working platform so as not to become entangled (Fig. 153).[b] For both these methods we have, however, been unable to find any textual reference.

The simplest device for making cord was the revolving mallet spindle *(hstian-chhui*[7]*-)* (Fig. 154), which has already been discussed in chapter (c).[c] As far as rope-making devices are concerned, it will be best to follow the *Nung Shu* of + 1313, because it constitutes the earliest and most reliable source on the subject. Thus, in describing the easily operated cordage hand-frame which was probably available in most peasant households, the *Nung Shu* (Book on Agriculture) says:[d]

The cordage hand-frame is a device to produce a one-fold (one-strand) cord *(jen-chhe hsien sheng chhiyeh*[3]*).* The *Thung Su Wen* says: a single (one-fold) cord is called *jen.*

The *Thung Su Wen* (Commonly Used Synonyms) of + 180 also states:[e]

Combining cords is called bringing together *(chiu)* ; the opening and rolling of the grass is called cording *(jen)* : the weaving of the cords is called plaiting *(pien*).*

Now we can continue with the text of the *Nung Shu*:[f]

[a] Siren (10), vol. 7, p. 180; Anon. *{764),* vol. 5.
[b] Wilshusen (1), p. 87. [°] See above, ch. *(c),* (2), (ii).
["] *MS,* ch. 22, pp. I5b-i6b; see also, *MCCS,* ch. 36, pp. 22ab; *STTH, (Mi-jiung),* ch. 9 pp. ioab.
[c] *Thung Su Wen,* ch. 61, p. 21a. ['] *MS,* ch. 22, pp. i6ab.

[1] 周官 [2] 旋椎 [3] 紡車鞭纏器也 [4] 辮



Fig. 153. Manufacture of bamboo ropes, Han-khou, *c.* 1909. Wilshusen (1), p. 87.

Wood is joined together to form a sort of two-pronged fork[a] which is fitted to an axle-handle in its centre. Its length can be about 30 cm. The upper parts of the prongs of the fork are used for the (processing) of the simple hempen bast. The right hand grasps the handle and makes the fork revolve. The left hand splices (the bast) by rolling it on the thigh where it becomes very tight in structure. Then it is wound around the fork. Sometimes they are used afterwards on the rope-making frame to combine several (of them) into tightly corded ropes. Peasants use (the material) to plait coarse hempen shoes,

[a] We have translated *chhiian'*, normally understood as a small wooden bowl, as fork.

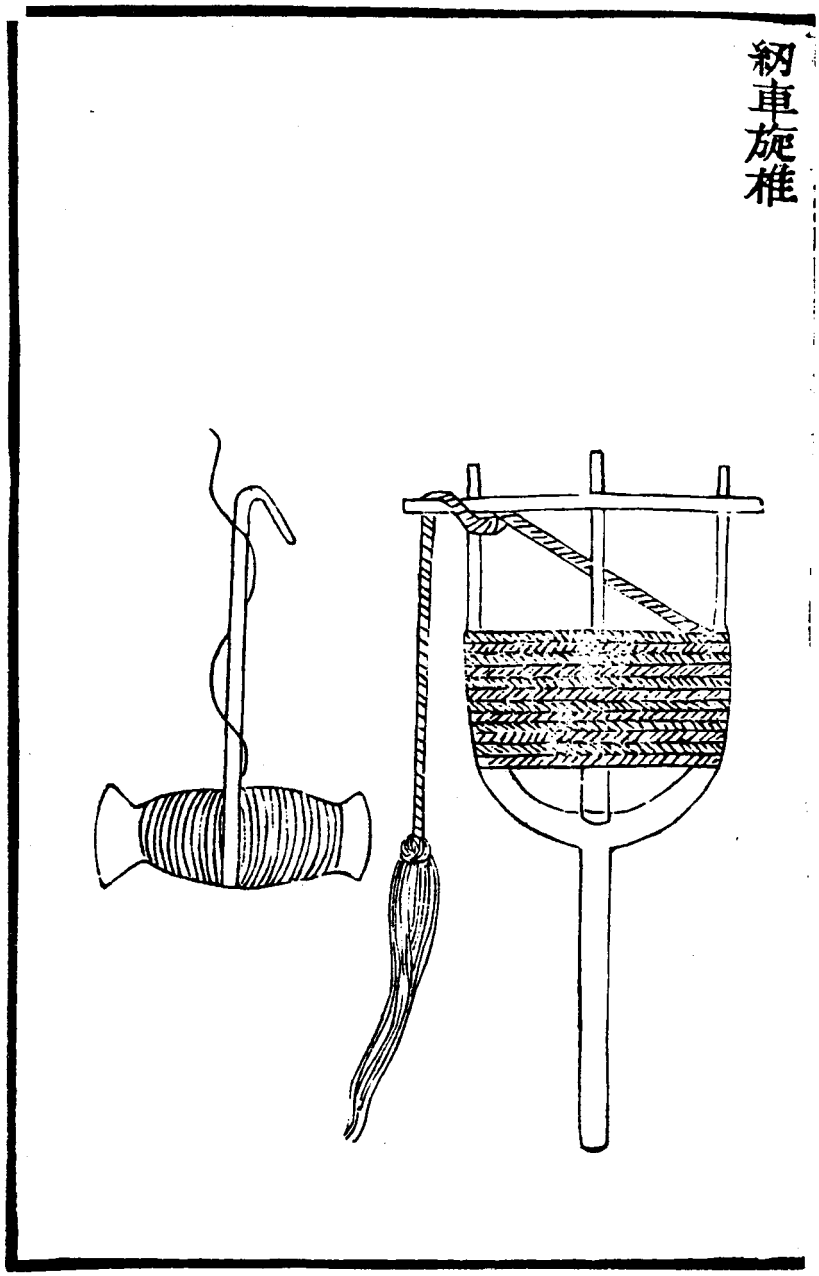


Fig. 154. Revolving mallet spindle (left) and cordage hand-frame (right), +1313. *NS*, ch. 22, p. 15b.



Fig. 155. Rope-maker, +1493. Der Ritter vom Turn (1), reproduced from Brandt (1), vol. 2, p. 58, Abb. 208.

rough blankets for the cattle, screens for windows and doors, matting and other items. The cordage hand-frame can differ in size.

The poem says:

> The body is the axle-handle, the head the two-pronged fork,
> The hempen threads are corded and wound completely around,
> Screens and matting are woven, the remainder still can be used,
> As warp and weft in cattle blankets, softer than a carpet made of felt.

This hand-operated instrument for the production of a **one-fold** cord **or a very** thick, coarse thread did not need any framework to support it. The **cord was** obviously used quite often in rope manufacture.

The cord-making reel *(phi-chhe*[1]*)* (Fig. 156), an ingenious fast working **and** labour-saving device for making cord, existed contemporaneously in China **and** in Europe. In + 1493 a translation from French into German of an educational book with woodcuts, originally composed about +1370 by the Chevalier de la Tour for instructing his daughters, was published in Basle. One illustration (Fig. 155) depicts the same type of cord-making reel as the one pictured in the *Nung Shu,* although the Chinese text to the illustration concentrates on technical details while the German edition presents a short 'educational' story, hardly suitable for the instruction of daughters. The explanation to the picture says: ' *Wie eyn seyler by eynem gelost eyns fiires eynem miinich sack uß siner kamer gon von sinem wibe.*[&] 'A rope-

» Brandt (i), vol. 2, p. 158, Abb. 208; *Der Ritter vom Turn* (1), p. 20.

[1] 紘車



Fig. 156. Cord-making reel (*phi-chhe*), +1313. *NS* (+1530 ed.), ch. 26, pp. 12ab.

maker saw (while working at night) in the flickering light of an open fire a monk leaving his wife's chamber.' The illicit relation resulted in a tragedy.

The *Nung Shu* says (Fig. 156) :[a]

The cord-making reel *(phi-chhe*[1]*)* is a device to join hemp fibres and to cord them tightly.

A framework with a height of about 60 cm is constructed. On its top a horizontal axle with a length of about 60 cm perforates it acting as the axle of the reel.

The left hand draws the hemp pulling the reel causing it to revolve, while the right hand cords the hempen fibres tightly into a cord which is afterwards wound around the reel. As soon as the reel is filled with cord, the cord is removed from the reel and handed over to the rope-making frame (for further processing) or other use is made of it.

The description provided by Wang Chen gives only a vague idea of what is happening in the working process. Luckily Rudolf P. Hommel[b] explained this type of cord-making device. From him we learn that the cord-maker started by

[a] *JVS*, ch. 22, pp. I3ab; see also, *JVCCS*, ch. 36, pp. 2oa-2ib; *STTH, (chhi-yung)*, ch. 9, p. 12a; *SSTK*, **ch. 78, pp. I5ab. 0 Hommel (1), p. 168, figs. 248, 249.**

[1] 紡車

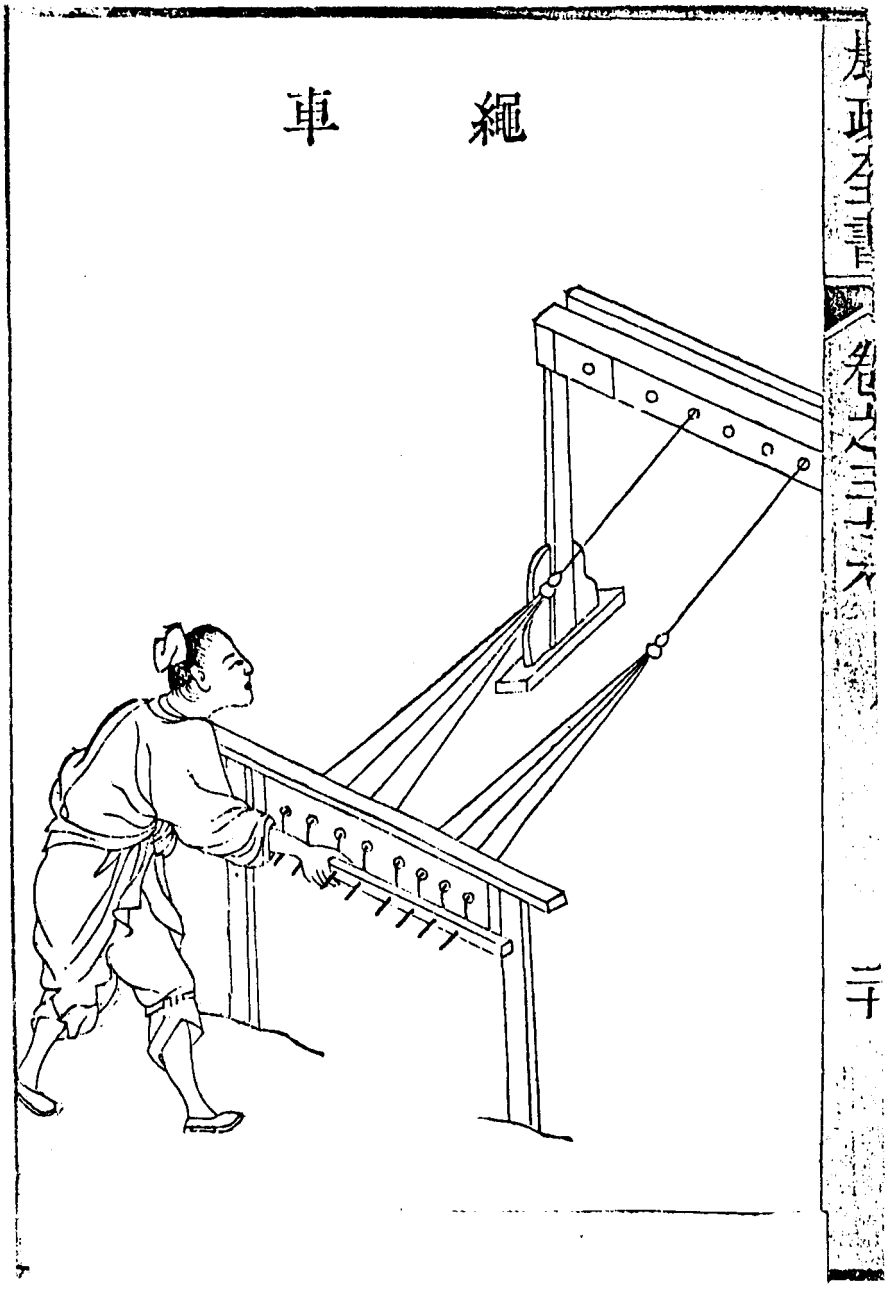


Fig. 157. Rope-frame (*sheng-chhe*), +1639. *NCCS*, ch. 36, p. 20b.

rolling fibres between hand and thigh. Thereafter the cord thus formed was tied to one of the braces of the reel. By simply taking the left hand with the fibre material and moving it in a circle, the reel was made to revolve, putting a twist into the cord. As soon as the twisted cord was long enough, the rope-maker had only to change the angle between cord and reel to ensure that it wound naturally. To guarantee easy rotation of the reel, its bearings were lubricated with peanut-oil. Having finished winding the cord, the rope-maker took up his former position, hooked the end of the twisted cord to one of the arms of the reel and resumed feeding the fibres as before.

Hommel mentions that this technique was used not only for spinning hempen cord, but also for spinning strands of rope made from palm fibres.[3.] In that case the spinner fed the fibres into the strand while walking backwards from the stationary wheel. This technique was also known in late medieval Europe, and is pictured in the *'Mendelschen Portraitbuck'* from Nuremberg, *c.* + 1393.[11]

The technically most advanced method of making ropes was to use a rope-frame *(sheng-chhe)'.* Its use spread all over China and it was employed not only in the countryside but also in the cities. The *Nung Shu,* the earliest pictorial and textual source providing evidence of this type of 'machine' in the world (Fig. 157), describes it as follows:[0]

The rope-frame twists (several) cords tightly together producing a rope.

The construction of the frame : First one erects a wooden framework, a stand. On top of the frame-posts a horizontal cross-board is placed which has a length of *c.* 150 cm and a width of *c.* 12 cm. (In the lengthwise direction and) always in the middle of the board eight holes are chiselled out in a row. Six holes are possible as well. In every hole a handle is placed, either made of iron or of wood, (and) shaped like a cattle-horn. Yet another horizontal beam is needed. The handles arranged in a row penetrate through the holes of this horizontal beam.

Apart from this wooden frame, another one has to be built in the same way. The two frames are set up face to face at a measured distance from each other.

Now the cords are arranged in a way that each of them is tied to the foot of a handle. In front of the frame stands the rope-maker. The beam with the handles (operating all the handles in parallel) is set revolving (by the worker) until the cords are evenly (drawn) and tight. Then (the worker) takes up three or four of them and brings them together to form one rope. (All cords) are tied with knots to the foot of one handle. So we reckon with making two (parallel) ropes at the same time.

Thereafter, another device made of wood, the so-called gourd-wood *(kua-mu[2])* (spacing-block or top) is placed at the beginning where the cords are combined into a rope. Again (the worker) turns the handles, (a motion) which tightens the cords into a rope. The spacing-block moves by itself. When the length of rope is complete, (the work) is stopped.

[a] Hommel (1), p. 168.

[b] Feldhaus (i), pp. 1020, Abb. 680 'Seiler in Nürnberg, um +1393; Blatt 16'; p. 1021 mentioning a rope-maker illustration of *c.* +1490, Blatt 108.

[c] *NS,* ch. 22, pp. I4a-i5a; see also, *NCCS,* ch. 36, pp. 2ob-2ib; *STTH, (chki-yung),* ch. 9, pp. 8ab.

[1] 繩車 [2] 瓜木

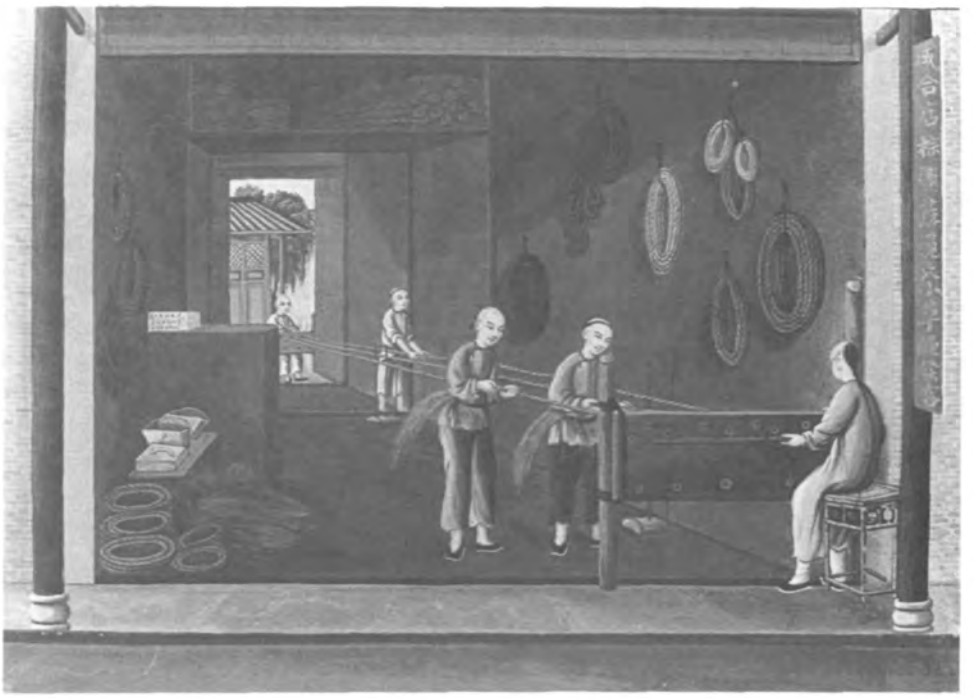


Fig. 158. Rope-maker's workshop Chheng-ho-tien 成合店, Kuangtung province, 19th century. Album, Überseemuseum Bremen.

Though the description tells us about the structure and function of the rope-frame as it was used for many centuries, both in China and in Europe,[a] some further details may be helpful.

In the first place, the two frames were used to make and control the thick cords which were stretched between them. This can be seen in the picture showing a rope-maker's workshop (Fig. 158). Afterwards, several cords could be made into one rope. Secondly, from the illustration in the *Nung Shu,* one gains the impression that both frames were fixed in the ground so as to be immovable; the text does not go into this point. From the illustration (Fig. 157) in the *Nung Cheng Chhiian Shu*[h] (Complete Treatise on Agriculture) we clearly see that the counter-frame could be slid along the floor like a kind of sledge with runners. Thirdly, the same illustration makes it clear that the eight strands were divided into two groups. Four strands—each of them singly fastened to its hook—were tied to a single hook at the counterframe. Thereafter the rope-making could start.

The *kua-mu,* spacing-block, was a rather important device. Made of wood and mostly conical shaped, it was provided with three equidistant grooves which merged towards each other at the thin end. The cords were laid into the grooves.

[a] Ponting (1), pp. 50-51 ; Diderot and d'Alembert (1), vol. I, pp. 630-1 ; Denhöfer (1) ; Mellenthin (1); Weber-Partenheimer (1), pp. 2-45.

[h] *NCCS,* ch. 36, p. 20b.



Fig. 159. Shop Chheng-chi-tien 成吉店, selling packaging material, Kuangtung province, 19th century. Album, Überseemuseum Bremen.

The thick end of the spacing-block points in the direction of the fixed frame.[a] It could be fitted with handles so as to be held by two workers, and its method of use was as follows. As the rope-frame was operated by one worker turning the beam having handles fixed to it, as well as by the person working the counter-frame, the spacing block was moved back towards the fixed frame, and caused the cords running through its grooves to become twisted over one another. This continued until the entire length of all the cords had been twisted together. Because the handles were turned continuously, the cords and the rope became progressively shorter. This finally caused the sledge-like frame, which was weighted down by a worker standing on its base and turning the single handle, to be dragged slowly towards the fixed frame.

Although we do not know very much about the history of rope-making in China, we may say that the rope-frame constituted the most important invention made in the field. The basic idea of its technical function is still in use today.

One final word. In China there were all kinds of shops for all sorts of items used in everyday life, even those which traded in packaging material, including ropes and cord, as may be seen in the illustration of the 19th century Chheng-chi-tien (Fig- 159)-

* Hommel, (1) p. 9, fig. 16.

(f) THE LEGEND OF SERICULTURE AND THE MATERIAL EVIDENCE OF SILK

Before approaching archaeological and written evidence about silk and its production, especially the various reeling techniques, we should try to understand the cultural significance of this animal product which occupied the minds of historians, officials and literati more than did any other natural fibre. To people without training in the natural sciences, its outstanding and, at the same time, incomprehensible qualities, explored and put to practical use by centuries of experience, demanded no ordinary explanation. Only a supernatural account of its discovery, the way its cultivation was taught and made popular by cultural heroes and heroines would suffice.

As we shall show below, it is necessary to distinguish between official sacrificial ceremonies and the sericultural cults of popular folk belief. For the latter occupied an important place within the whole system of belief in patron saints, which manifested itself in various ways.[a]

Apart from this, archaeological and written evidence make it certain that silk and its use go back to neolithic times; they give an indication of how it was appreciated as a textile product by the Shang aristocracy, and not only in economic terms. In its royal character, it can only be compared with contemporary items of bronze.

(i) SERICULTURAL DEITIES

In the traditional centres of sericulture such as Kiangsu and Szechwan provinces, the pantheon of sericultural female deities comprised many still insufficiently defined goddesses of minor mythological importance. Four—Lady Hsi-ling[1], Lady Yüan-yü'[2]and Princess Yii[3]and the 'horsehead' woman—presided over the rest of the pantheon.

In tracing the legend of the First Sericulturalist we find that as early as the Shang dynasty, diviners offered sacrifices to a silkworm spirit. The official sericultural ceremony, as we know it from the *Chou Li* (Record of the Institutions of the Chou Dynasty) and the *Li Chi* (Record of Rites), originated in the + ist century, during the Later Han dynasty. Lady Yüan-yü and Princess Yü can be regarded as the First Sericulturalists in the sense of being named first. In the Northern Chhi period (+ 550 to +581) the legendary emperor Huang-ti[4] (— 2698 to - 25g8)[b] was honoured as the First Sericulturalist. In the Northern Chou dynasty (+ 557 [to] +581) the final rationalisation of the legend occurred: Lady Hsi-ling,

» Chapter (/) is based on Kuhn (12).

[b] Giles (1), no. 871.

[1] 西陵 [2] 菀窬 [3] 寓 [4] 黃帝

the principal wife of Huang-ti, became the First Sericulturalist, which actually meant crediting a woman with this role, probably because women performed sericultural work in China. Furthermore, the sericultural ceremony of the empress constituted a parallel to the agricultural ceremony of the emperor.

For various reasons, the history of the performance of the official sacrificial ceremony in honour of the First Sericulturalist went through ups and downs until the end of the Northern Sung period. It was only executed sporadically in the + 12th century and in the + 16th century, but the Chhing emperor Kao-tsung (+ 1736 to + 1796) initiated the restoration of the ceremony; it was performed in + 1744 and + 1749.

Texts and illustrations mainly from the Sung to the Chhing dynasties reveal that the popular folk belief of ordinary silkworm breeders in the effectiveness of the First Sericulturalist and other deities of the pantheon, created a number of legends and stories. Hence it appears to be reasonable to date the beginning of sacrifices to the First Sericulturalist (and other deities) to Han times. Such sacrifices continued until the 20th century. From the +5th century, the + 13th, + 14th and the 19th centuries we have evidence confirming that this folk belief manifested itself in shrines to silkworm goddesses, which in Yuan times were furnished with lifesize statues of silkworm goddesses headed by Lady Hsi-ling.

The cult of the First Sericulturalist in the Chinese folk belief system led an independent life from the official sericultural ceremony performed by the empress. During the + ist millennium both flourished, but subsequently only the silkworm breeders' popular sacrificial cult survived. Obviously the latter was deeply rooted in the sericultural regions of China where the people hoped to secure and improve the economic basis of their livelihood by sacrificing to a sericultural patron saint, in particular Lady Hsi-ling.

(i) *The Legend and Identity of the First Sericulturalist*

A clarification and rationalisation of the legend of Lady Hsi-ling may not only add to our knowledge of Chinese mythology in general but also help revise our understanding of the 'officially' accepted traditions of Chinese sericulture which, until recently, was never seriously questioned.[11]

In a countless number of Chinese, Japanese and western books and articles dealing with Chinese cultural and technological achievements, or with problems of mythology, customs and ritual ceremonies, the authors repeat a legend of long standing which credits Lady Hsi-ling with the invention of sericulture and

[a] Research in this field has been done by Franke (u) and Bodde (25), pp. 263-72, and by Chinese and Japanese scholars; their works served for this subsection as fundamental presuppositions and hence have to be acknowledged at the outset: Franke (11), pp. 25-35; Chou Khuang-Ming (/), pp. 55-64; Yin Liang-Ying (/), pp. 1-17; Satö (/), vol. 1, pp. 37-42; Chou Yao (/), pp. 152-82; Kao Han-Yü (2), pp. 17-24; a historical abstract is also contained in the *KCTSCC, tshe* 492, ch. 35; *tshe* 722, ch. 237-8.

with the merit of having put it successfully into practice.* The *Shih Chi*' (Record of the Historian) informs us[b] that 'Huang-ti dwelt on the hillock of Hsien-yiian[2C] and married a woman from Hsi-ling, named Lei-tsu[3d] whom he made his principal wife'.[6] Regrettably, the *Shih Chi* does not supply its source of reference. The story of Lady Hsi-ling (= Lei-tsu) is usually told as follows:[1] 'The empress, known as the Lady of Hsi-ling, wife of a famous emperor, Huang-ti, encouraged cultivation of the mulberry tree, the rearing of the worms and the reeling of silk. This empress is said to have devoted herself personally to the care of silkworms, and she is credited by the Chinese with the invention of the loom.' 'From ancient antiquity she was (regarded as) the First Sericulturalist,'[8] the *Ku Chin Thu Shu Chi Chheng* (Imperial Encyclopaedia) of +1726 informs us. But this goes beyond the evidence. The legend of Hsi-ling as the Chinese and the western world knew it until recently, had its popular origin in a system of pre-Yuan folk belief, as may be concluded from sources which were classified as 'unorthodox'[11] by traditional standards of Chinese scholarship. To understand the origin of the legend and its context, it seems reasonable to begin with the Yellow Emperor[1] and explain how legend involves him in textile inventions.

Khung Ying-Ta[4] (+ 574 to + 648)' basing his remarks on a few words from the *I Ching*[s] (Book of Changes)—'they (Huang-ti, Yao and Shun) had been divine in transforming (conditions) so that people were content'[k]—gives the following commentary:[1]

'Before Huang-ti's time clothing was made from the skins of birds and animals, but as time went by people increased and animals were few, causing great hardship. So Huang-ti ordained that clothing should be made from silk and hemp cloth. This was how the spiritual ruler changed matters for the people's benefit.'

[a] **It is impossible to list even the most important works mentioning her name and the achievements attributed to her. For short references, see Giles (1), no. 677; *CWTTT*, no. 35587: 473.**

[b] ***Shih Chi*, ch. 1, p. 10.**

[c] **Hsien-yüan was the personal appellation of Huang-ti. The place is said to be in Hupei province.**

[d] The character *lei* could be written in various ways ¢, 1 1, 1¾ . The most common character **is** £ü which shows a woman, a field and silk. See also Münke (1), pp. 235-7.

[e] **Huang-ti had four wives and Hsi-ling was the first; see *Ti Wang Shih Chi*[e] (Record of Generations of** Emperors and Kings) by Huang-Fu Mi[7] (+ Q15 to +282) ; quoted in the *Shih Chi,* **p.** 10, **n. 4.**

[f] ***EB*, vol. 25, p. 97.**

[g] ***KCTSCC, tshe* 722, ch. 237, p. 81.**

[h] See **below, p. 257.**

1 For more information about the Yellow Emperor 'as a culture hero in Chou times' and about his influence on the development of Taoism, see Eichhorn (15), pp. 36, 104-6,108, 150; Münke (1), pp. 161-74.

1 Giles (1), no. 1055.

[k] *Chou I Cheng I*[s] (The Orthodox Interpretation of the Chou Book of Changes), ser. I, vol. 36, ch. 8 *Hsi-tzhu hsia,* p. 4 : *shen erh hua chih, shih min i chih*[9].

1 *Ibid.*

[1] 史記 [2] 軒轅 [3] 嫘祖 [4] 孔穎達 [5] 易經
[6] 帝王世紀 [7] 皇甫謐 [8] 周易正義 [9] 神而化之, 使民宜之.

Again, Huang-Fu Mi said about Huang-ti :[a]

'The Yellow Emperor let his upper and lower garments hang down (and the world was in order).'

And we can still find another reference :[b]

'The Yellow Emperor started to discard garments of skin, he made jackets in the image of heaven.'[0]

All these quotations about Huang-ti and the cultural achievements attributed to him in this field, reflect an old tradition of interpreting ancient texts which originated well before the Northern and Southern dynasties (prior to + 479) and which is considerably older than the Sung references to the Hsi-ling legend. We may conclude that the garments mentioned were made of silk, since the Yellow Emperor is said to have invented all fabrics, silk included. And in contradiction to what is printed in many publications,"[1] it was not Lady Hsi-ling who invented the loom but, according to a legend from Han times, one of Huang-ti's officials, called Po Yii[1]. The Prince of Huai-nan, Liu An[2e] (died - 122) informs us in the *Huai Nan Tzu*:*[1]

Po Yü was the first to make garments. Silk and hemp he spun into threads. With his hands he controlled the warp-threads, with his fingers he lifted them (in the weaving process). When the weave was completed, then (you had a fabric) like a net or gauze. Later generations built looms with a warp-beam and a cloth-beam. Their use made it more comfortable to weave (than it was during the lifetime of Po Yü).

So where does Lady Hsi-ling come in? As we shall now see, there are several acts to go before she enters the stage on which the legend of textile history is performed.

Certain Shang pictographs from oracle-bones maybe interpreted as being originally connected with silk technology. Apart from fragmentary silk traces, such pictographs demonstrate that silkworms and a silk technology were known to the Shang and were applied to the manufacture of cloth.[8]

Hu Hou-Hsüan[h] has given several examples to show that there were divinations concerning silkworms and the mulberry or invocations of the 'silkworm spirit'

* *Ti Wang Shih Chi* by Huang-Fu Mi quoted in *Chhu Hsiieh Chi** (Guide to Knowledge for Beginners) by Hsü Chien[5] (+659 to +729), ch. 21, p. 505: *Huang-ti chhui i shang (erh thien hsia chih)*[6]. For the completion in brackets, see *Pei Thang Shu Chhao*[1] (Book Records of the Northern Hall), compiled by Yü Shih-Nan[8] (+558 to +638) from *c.* +630, ch. 129, p. ib. The sentence can already be found in the *I Ching, Hsi-tzhu hsia,* 2.

[b] *Pei Thang Shu Chhao,* ch. 129, p. 1 b : *Huang-ti shih chhü phi-fu wet shang-i i hsiang thien yeh".*

[c] 'Image of heaven' probably refers to the shape of the Chinese jacket[10]; private correspondence with F. Bray, 18 March 1982.

[d] See above, p. 249.

[e] Giles (1), no. **1269.**

' Contained in Anon. (75^), *Tzu Shu Po Chia,* ch. 13, p. ia; Kuhn (3), p. 10.

B Kuhn (8), pp. 371-86. » Hu Hou-Hsüan *(8),* pp. 5-6.

[1] 伯余 [2] 劉安 [3] 淮南子 [4] 初學記 [5] 徐堅
[6] 黃帝垂衣裳(而天下治) [7] 北堂書鈔 [8] 虞世南
[9] 黃帝始去皮服爲上衣以象天也 [10] 衣

tshan-shen[1]. Among the oracle-bones of the Wu-ting period (— 1233 to — 1 i8o)[a], are four damaged fragments of which fragment 9 is the most complete.[b] This divination calls on the people to watch sericultural matters carefully *{hu sheng yii tshan*[2] *= hu jen sheng chha tshan-shih*[3]*).*° He therefore deduced that sericulture was an important industry in the Wu-ting period. Possibly, indeed, this inscription records the royal household's hopes for a good harvest of silkworms and asks the question about how likely it is that these hopes will be fulfilled. It also mentions the persons who are to blame in case of failure; the people who did not watch their business carefully and who neglected their duties. The inscription also appeals to the women who reared the silkworms to pay attention because sudden disease could destroy the whole breed. It could have appealed as well to those who gathered wild silkworms, because the thread may have been used for spun silk and to make padded clothing.

There are other examples from the Tsu-keng[4] (— 1179 to — 1173) and the Tsu-chia[5] (— 1172 to — 1140) periods,* telling us that three bovine animals were sacrificed to the 'silkworm spirit' *tshan-shih*[6] = *tshan-shen*[7] and five to another unidentified 'spirit' *jilan-shih** = *shang-chia*[9]*(?).*[e] A well-known case is the one translated by Keightley[f] and Satö[g] also explained by Hu Hou-hsiian[h] (Fig. 160 and Fig. 162) :

.. .Ta divined.. .ten *lao*[1] (to the ?) centipede clan spirit (?) five *lao,* (to the ?) silkworm altar stand, three *lao.* In the eighth moon.[11]

From the Lin-hsin[10] or Keng-ting[11] period (— 1139 to — 1130),[15] we have another divination (Fig. 161 ; Fig. 163) ;[l] which can be translated like this:

Divining on the day ping-yin (of an unknown month and year), (one or more) Chhiang (captives) have been brought to this place; should they be used in the sacrificial rites in honour *of tshan-shih* and (?)[12] *shih?*[m]

Keightley translated the inscription:

Divining on the day ping-yin : It should be that we cry out : ' Lead Chhiang (captives) and silkworm (?) to the X-altar stand (and) sacrifice (them)'."

[a] Keightley (2), p. 226, table 37.
» Hu Hou-Hsüan (<9), p. 7, n. 51 : Divination 9 is the most complete divination of the divinations 3, 4, 8 9. I, 2, 5, 6 and 7 have not been found.
[c] Nunome (7), p. 183. « Keightley (2), p. 226, table 37.
[e] Hu Hou-Hsüan *{8),* p. 6. ' Keightley (3), p. 49.
« Satö *(1),* p. 54.
» Hu Hou-Hsüan *{8),* p. 5; Nunome *(1),* p. 180, fig. 12-2. Lo Chen-Yü (6"), 1.28.6.
[1] A *lao* is traditionally explained as a sacrifice composed of one ox, one sheep and one pig, see Keightley **(3), p. 101.**
J This translation was suggested to me by David Keightley: private correspondence, 19 September 1980.
[k] Keightley (2), p. 226, table 37.
[1] Hu Hou-Hsüan *{8),* p. 6; Hu Hou-Hsüan (7), ch. 2, p. 49b no. 468; Satö *(1),* p. 54; Shima (?), p. 243. p. 243- [m] Satö (/), p. 54.
[n] Private communication; D. Keightley's letter of 19 September 1980.

[1] 蠶神 [2] 乎省于蠶 [3] 乎人省察蠶事 [4] 祖庚
[5] 祖甲 [6] 蠶示 [7] 蠶神 [8] 元示
[9] 上甲 [10] 廩辛 [11] 庚丁 [12] 鬼

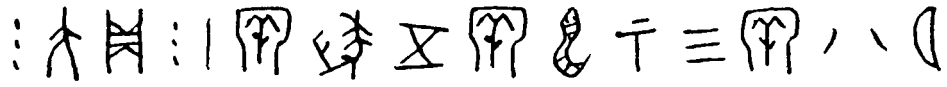


Fig. 160. Oracle-bone inscription, Shang dynasty. Lo Chen-Yü (*6*), I.28.6; Shima Kunio (*2*), p. 243.



Fig. 161. Oracle-bone inscription. Shang dynasty. Hu Hou-Hsüan (*7*), p. 468; Shima Kunio (*2*), pp. 2–3.



Fig. 162.

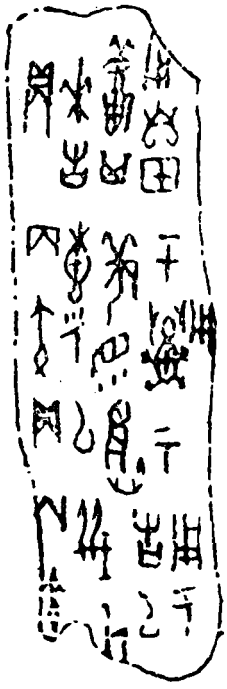


Fig. 163.

Fig. 162. Reproduction of oracle-bone with inscription. Shang dynasty. Lo Chen-Yü (*6*), 1.28.6 (see Fig. 160).
Fig. 163. Reproduction of oracle-bone with inscription, Shang dynasty. Hu Hou-Hsüan (*7*), p. 468 (see Fig. 161).

We may deduce from this inscription that in the — 12th century at least, human sacrifices to the 'silkworm spirit' were common.[a]

The whole tradition of sacrifices to the *tshan-shen* of the Shang period was lost during the early centuries of the Chou period. From Chou times we know only of sericultural ceremonies performed by the empress and her court ladies. Once a

[a] Chhen Chüan-Chüan *(1)*, p. 70.

year in April she started the sericultural season in a ceremony of gathering mulberry leaves and offering silk garments, an activity which can be compared with the ceremonial ploughing by the emperor.[a]

We may assume that in place of the ancient 'silkworm spirit', a sericultural ceremony sprang up in honour of the *hsien-tshan*[1], the First Sericulturalist, in Han times. The First Sericulturalist would then be a fairly new creation, and this would explain the uncertainty and the indecision of the Chinese officials over the question of where to place the altar for performing the ritual.[b]

Empresses personally took part in sericulture, more or less in accordance with and based on the general rules of the procedure as expressed in the *Chou Li* and *Li Chi*.[c] Only in Han times, in the 2nd year of the reign period Yung-phing[2] (+ 95) of the emperor Ming-ti[3], was the ' silkworm goddess ' *tshan-shen* personified.[d]

' (The empress) sacrifices to the First Sericulturalist according to the ritual with a small sacrifice *(tzhu hsien-tshan li i shao-lao*).'*

And the *Han Chiu I*[s] (Old Ceremonies of the Han) adds :[e]

'When in spring the mulberry trees prosper, the empress attends the plucking of mulberry leaves. In the garden there is the house for the silkworms where they are reared on hurdles without number. As a sacrifice a middle sacrifice' consisting of a sheep and a pig is performed. Nowadays the silkworm goddesses are named Lady Yüan-yü[6] and Princess Yii[7],[g] (and are) two goddesses *(chin tshan-shen yüeh Yüan-yü fu-jen Tü-shih kung-chufan erh shen[8]).'*

Kan Pao (+4th century)[h] of the Chin dynasty informs us in his *Sou Shen Chi* (Legends of the Supernatural) that because of this tradition from ancient times, sericulture was considered as a woman's affair and Lady Yüan-yü was the First Sericulturalist.[1]

[a] **Couvreur (3), vol. 1, p. 350; vol. 2, pp. 294, 322; Biot (1), vol. 1, p. 146. The subject received attention** from Franke (n), pp. 25-31 and needs no detailed discussion here.

[b] **Werner Eichhorn (15), p. 173.**

[c] The *MS* (+1530), ch. 22, pp. ib-2b reports that empresses participated in sericultural ceremonies in the reign periods listed below; sometimes only the dynastic title is given: **Han** emperor **Wen-ti** (— 167), **Han emperor Ching-ti (— 142), Han emperor Yiian-ti (— 48 to —33), Han emperor Ming-ti (+ 58 to +75); Wei emperor Wen-ti, 7th year of the reign period Huang-chhu (+ 226) ; Chin emperor Wu-ti, reign period Thai-khang (+ 286 to +289); Sung emperor Hsiao-wu-ti (+ 454 to +465); Thang emperor Thai-tsung, first year of the reign period Chen-kuan (+ 627), Thang emperor Kao-tsung, first year of the reign period** Hsien-chhing (+ 656), Thang emperor Ming-huang-ti, 2nd year of the reign period Hsien-thien (+ 713), Thang emperor Hsüan-tsung, reign period Khai-yüan (+ 713 to + 741, Thang emperor Su-tsung, 2nd year of the reign period Chhien-yiian (+ 759); Sung emperor Thai-tsu, reign period Khai-pao (+ 968 to +975).

From the *WHTK*, vol. 1, p. 794 we may add the years: +652, +669, +672, +675, all from the reign of emperor Kao-tsung.

[d] ***Hou Han Shu*, p. 3110.**

[e] ***Ibid.***

' **That the *Hou Han Shu* text mentions a small, and the commentary to it a middle-sized sacrifice also attests to the confusion which existed in this ritual of Han times.**

« **This part of the sentence defining the two women as the silkworm goddesses is also quoted in the *Chin Shu*, ch. 19, p. 590. The characters *Yüan-yü* can also be written % JS;** [see] ***CWTTT*, 31539: 20.**

[h] **Giles (1), no. 935.**

• ***Sou Shen Chi*, vol. 3, ch. 14, p. 5b.**

[1] 先蠶 [2] 永平 [3] 明帝 [4] 祠先蠶禮以少牢 [5] 漢舊儀
[6] 菀窳 [7] 寓 [8] 今蠶神曰菀窳婦人寓氏公主凡二神

In the reign period Thai-khang[1], the sixth year (+285) of the Chin emperor Wu-ti[2] 'we hear not only of an altar for the First Sericulturalist, but also of a silkworm palace *{tshan-kung*)* built for rearing silkworms which was supervised personally by the empress.[8.] Sacrifices offered to the First Sericulturalist are also recorded from about +320 in the reign period Thai-hsing[4] of the emperor Yuan-ti[5].[b] In the fourth year of his reign period Ta-ming[6] (+460) the (Liu) Sung emperor Hsiao-wu-ti[7] constructed a silkworm temple *(tshan-kuan[s]),*[c] situated in Pai-shih-li[9] west of Thai-chheng[10], the imperial part of the capital city Chien-khang", now Nanking.

Although the sacrificial ceremony of the First Sericulturalist was well established by then, confusion about the identity of the First Sericulturalist persisted. As far as we can tell, the Lady Yüan-yü and the Princess Yü completely lost their importance after Han times.[d] It seems either that the identity of the First Sericulturalist was so well-known that no further name had to be added to explain it, or Chinese ritualists encountered difficulties in identifying the First Sericulturalist, and so omitted to personify the 'title'.

In the second year of the reign period Chien-wu[12] (+495) of the emperor Ming-ti[13] from the Southern Chhi dynasty, Huang-ti is credited with the tradition of teaching in sericultural matters,[e] and in the Northern Chhi period (+550 to +581), he was honoured with a sacrifice as the First Sericulturalist. The sentence reads:'

In the Northern Chhi period in the third month of spring, a sacrifice was offered to the First Sericulturalist Huang-ti.

In the Northern Chou dynasty (+557 to +581) the final rationalisation of the legend appears, crediting a woman with having been the First Sericulturalist, probably because of the fact that sericultural work in China and elsewhere was always performed by women. Yet prior to the Northern Chou dynasty, emphasis on Confucian values almost completely excluded any possibility of culture heroines,[8] so, identifying the First Sericulturalist as Lady Hsi-ling constituted an attempt to reconcile the contradictions between popular culture and official creed.[h] When the empress personally offered the great sacrifice to the wife of

[a] *Chin Shu,* ch. 19, p. 590. [b] *Chin Shu,* ch. 25, p. 765.
[0] *Sui Shu,* ch. 7, p. 145.
[d] The ladies are mentioned again in the *Tshan Shu* (Treatise on Sericulture) off. + 1090 by Chhin Kuan, p. 3. He probably quoted from the *Chin Shu* without giving the source.
e *Man Chhi Shu,* ch. 6, p. 86.
' *Sut Shu,* ch. 7, p. 145; *Lu Shih* (A History of China from High Antiquity to the Eastern Han Dynasty) by Lo Pi, + 1170, *hou-chi*[4], ch. 5, p. 13b.
« Lady Yüan-yü and Princess Yü were not culture heroines in the proper sense because apart from their names nothing is known about them.
[b] We are indebted to Francesca Bray who brought this point to our attention.

[1] 泰康 [2] 武帝 [3] 蠶宮 [4] 太興 [5] 元帝
[6] 大明 [7] 孝武帝 [8] 蠶觀 [9] 白石里 [10] 台成
[11] 建康 [12] 建武 [13] 明帝 [14] 後紀

Huang-ti, Lady Hsi-ling, then the identity as we know it from the tradition was established for the first time. The essential part of the sentence reads:[a]

(The empress) offers in sacrifice to the First Sericulturalist, the goddess Lady Hsi-ling *(chin tien hsien-tshan Hsi-ling shih shen[1]).*

In the Thang dynasty annals we find the First Sericulturalist mentioned, but without comments on his or her identity.[1]» It seems as if no more attention was paid in the Chinese texts to either personified tradition, that of Huang-ti or of Lady Hsi-ling. But such is not the case. In the first half of the +8th century emperor Huang, Lady Hsi-ling, Lady Yüan-yü and Princess Yü and Thien-ssu[2c] were regarded as the spirits of the First Sericulturalist.[4] The identification of the spirit, which had finally become a materialised personified deity, changed in the course of time. By the end of the Thang dynasty the Chinese had no doubt as to the First Sericulturalist's identity: they simply knew that Lady Hsi-ling personified the First Sericulturalist. This view is supported by a quotation from the *Hsii Shih Shih* (Continuation of the Beginnings of Things) by Ma Chien, an official of the Former Shu dynasty (+891 to +925) of the Five Dynasties period. It says:[e]

Lady Hsi-ling, the principal wife of Huang-ti, started rearing silkworms to get silk. In the *Li Chi* offerings are presented to the First Sericulturalist who is Lady Hsi-ling *(Huang-ti-yiian-fei Hsi-ling shih shih jang tshan wei ssu Li Chi hsiang yiian-tshan' chi Hsi-ling shih y eh[3]).*

In the first year of the reign period Cheng-ho[4] (+1111) of the Sung emperor Hui-tsung[5] we read:[8]

The ceremony of the First Sericulturalist has long been abolished.

A 'new' sericultural ceremonial was then officially initiated, but it never acquired the same importance that it had in the past, in fact the cult deteriorated into a subject of ritual textbooks, as we may judge from the Chinese annals where the tradition of Lady Hsi-ling as the First Sericulturalist was not an officially accepted version. The extremely difficult political situation in the last years of the Northern Sung dynasty, which came to an end in +1127, probably explains why ritual questions of relatively minor interest failed to receive proper attention. However,

* *Sut Shu,* ch. 7, p. 145; *Lu Shih, (hou-chi),* ch. 5, p. 13b explains: *Hou-Chou huang-hou chi hsien-tshan Hsi-ling shih*',* in the Later Chou period the empress sacrificed to the First Sericulturalist Lady Hsi-ling.

" *Chiu Thang Shu,* ch. 21, p. 819; ch. 24, p. 910; *Hsin Thang Shu,* ch. 12, p. 326; ch. 15, p. 369; *Sung Shih,* ch. 102, p. 2493; *KCTSCC, tshe* 722, ch. 237, p. 83.

0 *Sung Shih,* ch. 102, p. 2494.

d *Tiieh Ling Shih* (Explanation of the Seasons), in *WHTK,* vol. **1,** p. 797.

e *Hsii Shih Shih,* in *Shuo Fu,* ch. 10, p. 45a.

' **Here** *yiian-tshan* is substituted for *hsien-tshan* with no change in the meaning.

t *Sung Shih,* ch. 102, p. 2493.

1 進奠先蠶西陵氏神 2 天駟

3 黃帝元妃西陵氏始養蠶爲絲禮記享元蠶即西陵氏也 4 政和

5 徽宗 6 後周皇后祭先蠶西陵氏

the official ritual produced yet another solution to the problem of identity; an unidentified but personified figure named First Sericulturalist *(hsien-tshan shift[1]).** This Sung interpretation was clearly an official attempt to solve the problem of identifying the First Sericulturalist once and for all. In this they succeeded, at least insofar as the official records are concerned,[b] but they could not save the sericultural ceremony with a sacrifice to the faceless First Sericulturalist from being condemned to insignificance.

The court launched two attempts to revive the ritual of the First Sericulturalist, one in + 1132 and the other in + 1145, both of which failed.[0] In the Ming dynasty Hsia Yen[2] (+ 1482 to + i548)[d] suggested to the emperor that the empress should perform the ceremony of cultivating silkworms—a ritual by which women might learn feminine virtues.[e] The emperor Shih-tsung[3] adopted his suggestion and in + 1530 re-animated the sericultural ceremony after 400 years of neglect; but it was not long before the ceremony was abolished.[1] In + 1742 emperor Kao-tsung started the final attempt to institutionalise the sericultural ceremonial, which was performed in + 1744.[8]

Here we may ask why the sericultural ceremony came to an end in the Southern Sung dynasty and why it was abandoned in the + 16th century? As a preliminary answer we suggest the following reasons. After the Southern Sung dynasty had collapsed in +1127 [tne] emperor Kao-tsung had to choose a new capital. In + 1138, after long discussions, Hangchou was, reluctantly, designated as *hsing-tsai*[4] 'temporary capital'. From a cosmological point of view, Hangchou must have been a minor catastrophe, for official ritualists encountered tremendous difficulties in establishing the most essential altars for the state ceremonies.[11] Hence it is not surprising that the ceremony of the First Sericulturalist had no chance of survival. In the Yuan dynasty Ta-tu (Peking) was made capital of China. Apart from a few decades at the beginning of the Ming dynasty when the emperor designated Nanking his capital (+ 1368 to + 1402), China was ruled from Peking, a city which never played a role in the history of Chinese sericulture. So when the emperor tried to have the sericultural ceremony performed, either essential presuppositions were lacking or could not be brought into harmony with the ceremony's underlying idea. An additional reason was that a sericultural ceremony only made sense in a region where people earned their living from sericulture; Peking was too far away from centres of sericultural practice for even the theoretical tradition of sericulture to be kept alive. To people actively involved in

[ft] *Ibid.,* p. 2495: 3rd year of the reign period Hsüan-ho[5] (+ 1121); we find the *hsien-tshan shih* already mentioned *c.* + 1080, see *Sung Shih,* ch. 102, p. 1494.

[b] See the quotations in *KCTSCC, tshe* 722, ch. 237, 238. The only exception is from the reign period Chhien-lung of the Chhing emperor Kao-tsung.

[c] *WHTK,* ch. 87, p. 797. *A MB,* vol. 1, pp. 527-31.

[e] *Ibid.,* vol. 1, p. 527.

['] *Ming Shih,* ch. 49, pp. 1273-6; *KCTSCC, tshe* 722, ch. 238, p. 87.

[8] *Chhing Shih Kao,* ch. 83, pp. 2519-21. [h] Wright (10), pp. 63-6.

[1] 先蠶氏 [2] 夏言 [3] 世宗 [4] 行在 [5] 宣和

sericulture, however, rituals to assure a good crop were most important, and this is the basis for a folk tradition of sacrifices to the First Sericulturalist.

Let us turn now to unofficial Sung publications and see what they say about the First Sericulturalist. From the fourth year of the reign period Ching-te" (+1006) we already hear that emperor Chen-tsung* announced the restoration of the First Sericulturalist's *sacrifice* (hsien-tshan-ssu*[3]). The official and scholar Liu Shu[4] (+ 1032 to + 1078)[15] informs us in his *Tzu Chih Thung Chien Wai Chi* (Additional Chronicle to the Comprehensive Mirror for Aid in Government),[c] an unorthodox interpretation of history, as well as Kao Chheng in the *Shih Wu Chi Yuan* (Record of the Origin of Things)[d] *(c.* +1075 to +1085) that Fu Hsi[5] (-2953 to -2838),[6] the first of the Five Emperors of the legendary period, transformed silkworms so that they could make silk and Lady Hsi-ling was said to have started rearing them.[1] The *Lu Shih* contains an even more definite statement:[8]

(Because Hsi-ling) started the rearing of silkworms, sacrifices are offered (to her as) the First Sericulturalist.

The *Ku Chin Thu Shu Chi Chheng* (Imperial Encyclopaedia) of +1726 includes another quotation from the *Tzu Chih Thung Chien Wai Chi* repeating the already known story of Lady Hsi-ling but adding:[h]

Hsi-ling ... started to teach the people the rearing of silkworms and the reeling of silk so that they could offer garments (in the sericultural ceremony). Subsequent generations sacrificed to her as the First Sericulturalist. *(Hsi-ling.. .shih chiao minyii tshan chih ssu-chien i kung i-fu hou-shih ssu wei hsien-tshan[b]).*

As we have learned, only a few references from the Northern Chou dynasty (+ 557 [to] +5[81])>[tne] former Shu dynasty (+891 to +925) and the Sung dynasty (+ 960 to +1279) identify Lady Hsi-ling with the First Sericulturalist. Many come close to such an identification but do not explicitly confirm it.

(ii) *The Pantheon of Popular Sericultural Goddesses*

Regrettably, Lady Hsi-ling as legendary culture heroine and goddess of sericulture was not one of the favourite subjects of pictorial art in China. Apart from illustrations, mostly woodcuts which have their origin in the superstitious folk

» ***KCTSCC, tshe* 722, ch. 237, p. 86.**
[6] ***SB,* vol. 2, pp. 654-5.** ° ***SBB,* p. 72.**
[d] ***Shih Wu Chi Yuan* ch. 9, p. 326; see also *NS* (+1530), ch. 22, p. 5b; Satö (/), p. 38.**
[e] **Giles (1), no. 585.**
' *Shih Wu Chi Titan,* ch. 9, p. 326; *'tshan-ssu—Fu Hsi hua tshan wei ssu Hsi-ling shih shih yang tshan".'* **The statement can also be found in *Lu Shih, (hou-chi),* ch. 5, p. 10a.**
[g] ***Lu Shih, (hou-chi),* ch. 5, p. 10a.**
"» *KCTSCC, tshe* 722, ch. 238, p. 81.

[1] 景德 [2] 眞宗 [3] 先蠶祀 [4] 劉恕 [5] 伏羲
[6] 西陵…始教民育蠶治絲繭以拱衣服後世祀爲先蠶
[7] 蠶絲—伏羲化蠶爲絲西陵氏始養蠶



Fig. 164. Goddess of silkworms (*tshan-mu niang-niang*), 19th century (?). By courtesy of the Hamburgisches Museum für Völkerkunde, Hamburg (Inv. No. 32.159: 386).

belief in patron saints (Fig. 164), she did not even become a subject of minor interest. During each seasonal cycle of sericulture, such prints were usually pasted on a wall, and because their production was almost solely to satisfy this demand, it is not surprising that there are only a few authoritative pictures of her still extant.

To obtain data which are historically reliable we have to analyse the illustrations from the *Nung Shu* (Book on Agriculture) of + 1313 by Wang Chen.[a]

Before discussing the goddess herself, let us first have a look at the illustration 'Altar of the First Sericulturalist' *{hsien-tshan-than*[1]*)* from the +1530 edition[0] which shows the official ceremony (Fig. 165).° Ideally, the official ceremony took

[a] For his life and the importance of his work, see Chang Hun-Sheng, Chhen Shih-Chiin (/), pp. 266-79.

[6] The two best known editions have been consulted: the edition in 22 chüan, published by the Wu-ying-tien press with a preface from + 1774, completed in + 1783 which was based on the lost *Nung Shu* manuscript from the *Tung Lo Ta Tien* of + 1407; the other edition is from + 1530, the Ming Chia-ching edition in 36 chüan, the illustrations of which reflect the more refined Ming taste with its predilection for elaboration in detail and its preference for proper display. For full bibliographical reference, see Kuhn (1), pp. 16-18.

[c] JVS (+1530), ch. 22, p. 5a; *MS*, ch. 20, p. 5a; the illustration in this edition has no inscription on the tablet.

[1] 先蠶壇



Fig. 165. Altar of the First Sericulturalist (*hsien-tshan-than*), +1313. *NS* (+1530 ed.), ch. 22, p. 5a.

place out of doors once an auspicious day in the old Chinese third month had been chosen[a]—mostly in the second half of April[b]—when the actual sericultural season had already started. The empress proceeded directly towards the altar which normally was placed on a terrace. In various dynasties it measured anything from some 150 cm to 300 cm above ground level and was about 6 to 10 m square. Steps on all four sides some 150 cm wide led up to it.[c] The empress can be seen at the bottom centre and the altar almost at the top centre of the picture. Court ladies are arranged in symmetrical groups each side of the empress to attend and accompany her. A tablet inscribed *hsien-tshan* stands on the altar. The stiff and symmetrical composition of the ceremonial scene reflects the official character of the ritual.

In the text paragraph on the altar of the First Sericulturalist we find the sentence :[d]

Lady Hsi-ling, the principal wife of Huang-ti, started to rear silkworms and so was the First Sericulturalist.

This statement was still valid as a folk belief at the end of the 19th century, and probably even in the early decades of the 20th century; it expressed popular notions of a sericultural patron saint.[e] The artist who drew the illustration before it was cut into wood, probably based the whole composition on another older pictorial source unknown to us. He certainly could not have witnessed the ceremony performed by the empress, simply because it never existed in Yuan times. Because the *Nung Shu* is a highly reliable source, written by a competent agriculturalist, we may conclude that the illustration comes very close to what actually happened in the ceremony in Sung times. Furthermore we can be sure that in the Yuan period, Lady Hsi-ling was clearly understood and generally known as the First Sericulturalist.

The illustrations entitled 'Goddesses of silkworms' *tshan-sken*[1] from both *Nung Shu* editions' (Fig. 166; Fig. 167) and from the *San Tshai Thu Hui* (Universal Encyclopedia) of +1607/ (Fig. 168), based on the picture in the +1530 *Nung Shu* edition, are our most detailed pictures of the goddesses of silkworms or of sericulture, interpreted in a broader sense.

Eight female goddesses and one male worshipper (Fig. 166), and elderly female • worshippers (Figs. 167 and 168) are depicted in the illustrations; the worshippers offering sacrifices and burning incense. Above them there is the *thien-ssu-hsing*[1], 'the team of four horses'—a constellation consisting of the stars *ß, S, n* and *v*

» *Sung Skih,* ch. ioa, pp. 2495, 2497.
[b] *Sui Shu,* ch. 7, p. 145.
[c] *MS,* ch. 20, pp. 5b-6a; Franke (11), pp. 29-30.
•> *MS,* ch. 20, p. 5b; *M* (+1530), ch. 22, p. 5b.
[e] *TSTP,* ch. 11, p. 21b.
' JV5 (+1530), ch. 22, pp. 7ab; *NS,* ch. 20, p. 7a.
[g] *STTH, {jen-wu),* ch. I, pp. I4ab; it was recently reproduced in: Ebert and Kaulbach (1), p. 60, Abb. 40.

[1] 蠶神 [2] 天駟星



Fig. 166. Goddesses of silkworms (*tshan-shen*), +1313. *NS* (+1530 ed.), ch. 22, pp. 7ab.

Scorpii—which, according to legend, could also have been the spirit of the First Sericulturalist. Chinese tradition attributed to silkworms and horses the same sort of vital energy,[0] probably because 'the constellation' reached its highest point in the night sky at the vernal equinox, when the silkworm season usually started. So the interpretation may have sprung up that 'the team of four horses' represented the animal spirit of the silkworm *(tshan-ching[1])* .[b] To distinguish the essence of 'the team of four horses' from Lady Hsi-ling, the text of the *Nung Shu* continues denning her as the First Sericulturalist."

In the + 1530 edition Lady Hsi-ling, in a lavish attire of patterned robes which excel all those around her, is seated in a central position, just below the *thien-ssu* constellation and attended by two servants. She presides over the other five goddesses. The hierarchy is evident. Above her head a horizontal inscription tells us that the lady is Hsi-ling, the First Sericulturalist *(shih-tshan[2])* ,[d] the principal wife of Huang-ti. Although her position in the pantheon was well established by

[a] For more information see Schlegel (5), p. 659; Franke (11), p. 176, n. 93; Biot (1), vol. 2, p. 190, n. 2.
" *MS* (+1530), ch. 22, p. 8b. [c] JVS (+1530), ch. 22, p. 8b.
[d] The inscription says *shih-tshan;* the text says *hsien-tshan.* The titles mean the same: First Sericulturalist. See *Sung Shih,* ch. 102, p. 2494.

[1] 蠶精 [2] 始蠶



Fig. 167. Goddesses of silkworms (*tshan-shen*), +1313. *NS*, ch. 20, p. 7a.



Fig. 168. Goddesses of silkworms, +1609. *STTH*, (*jen-wu*), ch. 1, pp. 14ab.

then, it was not until +1742 that this personified First Sericulturalist received official recognition and promotion which entitled her to a divine seat, an altar where she could be worshipped."[1]

To the left of Lady Hsi-ling three goddesses are placed, Lady Yüan-yü, Princess Yü and San-ku 'third aunt', to the right two goddesses, the 'horsehead' woman *(ma-thou-niang)* and the 'mother of silkworms' *(tshan-mu).*

The names of Lady Yüan-yü and Princess Yü appeared for the first time in the Han dynasty as mentioned previously,[b] but unfortunately we know nothing else about the legendary women. In the +1530 *Nung Shu* edition *Tiian-yii fu-jen Tii-skih kung-chu*[1] is understood to be one person, as can be seen from the vertical inscription on the illustration (Fig. 166), but in the *Nung Shu* edition, based on the *TungLo Ta Tien* manuscript, two persons are distinguished and labelled (Fig. 167).

Ta-ku[2]—'great aunt' (only in the +1530 edition)—and *San-ku** 'third aunt' are silkworm goddesses of popular belief, in evidence only between Yuan and

[a] *Chhing Shih Kao,* ch. 83, p. 2520.
[b] See above, ch. (/) (1).

[1] 宛窳婦人寓氏公主 [2] 大姑 [3] 三姑

Chhing times. With the *Erh-ku*[1] 'second aunt' they were thought to belong to the staff of silkworm houses and to take alternate charge of the silkworms.* *San-ku* may also have been another name for 'mother of silkworms' *(tshan-mu)* and *San-niang*[2], who in Yuan times in Szechwan province was identified as the silkworm woman *(tshan-nii*[3]*)*,[b] called 'horsehead' woman. We have not yet found any more reliable information.[0]

On the right-hand side of Lady Hsi-ling, the 'horsehead' woman and the 'mother of silkworms' *(tshan-mu*)* are placed. From the sixth year of the reign period Thai-khang[5] (+285) of the Chin emperor Wu-ti[6] we know that six women from the people[4] or six ladies[e] were chosen to act as ' mothers of silkworms '. They attended the silkworms of the empress in the 'silkworm palace' *(tshan-kung*[1]*)*, which in practice meant feeding and keeping them "in hygienic conditions. 'Women of the silkworms' *(tshan-niang*)*[1] was just another name for them. In our illustrations one of the six, evidently *pars pro toto,* is depicted.

Apart from Lady Hsi-ling, the 'horsehead' woman *(ma-thou-niang*[9]*)*—a horse's head can be seen behind the woman on her left—deserves most attention. Various versions of the story *Thai Ku Tshan Ma Chi*[10] (The Story from Ancient Antiquity of how the Horse Changed into a Silkworm) are extant.[8] The oldest version known to us probably originated in Szechwan province[11] and is contained in the *Sou Shen Chi* (Legends of the Supernatural) from the +4th century.[1] Perhaps we should tell the story in a few words:[5]

In remote antiquity a man had been far away from home for a long time. Back at home there were only his daughter and a stallion. The young woman was anxious about her father's absence and jestingly she said to the stallion: ' If you could bring my father back, I would marry you.' After having heard this, the horse shook off his halter and galloped away; it returned with the father. Afterwards, every time the stallion saw the young woman it was seized by sudden passion. The father thought the horse's behaviour strange and asked his daughter about it. She answered him, telling the truth about the promise; he felt great anger and refused to keep it. Instead he killed the horse, flayed it and dried the hide in the sun. When the young woman went to the place where the hide was stretched, it suddenly moved and wrapped itself around the young woman and flew away. Afterwards the woman and the hide were found on a branch; eventually they turned into a silkworm and died.

[a] *CWTTT,* 10: 823: based on information from the *Thung Su Pien* (Compilation of Used Synonyms) by Chai Hao (preface of + 1751). [b] *NS* (+ 1530), ch. 22, p. 8a.
[c] For information about the gods of silkworms, see Werner (1), p. 447.
[a] *Sung Shu,* ch. 14, p. 355. [e] *Chin Shu,* ch. 19, p. 590.
[I] Commentary in the *CWTTT,* 34720: 10.
* See *CWTTT,* 45550:82; 34720: 10. For other versions translated into English and German, see Werner (/), pp. 517-18; Prunner (1), pp. 44-5; Miinke (/), pp. 235-7. We are obliged to Mrs Mari Makinose who brought a Japanese version of the story, known in Japan as a fairy tale, to our attention; see Ozawa Toshio (1), pp. 49-50.
[II] JVS (+ 1530), ch. 22, p. 8b. ' *Sou Shen Chi,* ch. 14, pp. 4b-5a.
J Here the version from the *Shih Wu Chi Yuan,* ch. 9, p. 326 is translated.

[1] 二姑 [2] 三娘 [3] 蠶女 [4] 蠶母 [5] 泰康
[6] 武帝 [7] 蠶宮 [8] 蠶娘 [9] 馬頭娘 [10] 太古蠶馬記

All subsequent stories about the horse and the young woman turning into a silkworm which finally became the 'horsehead' silkworm goddess—some having 'happy endings' with riches due to silk—are based on this story. This fairy tale probably originated in a rural earthbound community. No cultural heroes and heroines were involved in creating silkworms but a metamorphosis occurred. This horse-silkworm relation is also nourished by the popular belief in China and Japan that the 'heads' of silkworms nod as the heads of horses do.[a]

Having identified the goddesses, who may have been identical with the 'five saints of newly hatched silkworms' *(tshan-hua wu-sheng*[1]*)* ofKuangtung province in the Chhing dynasty,[b] another question arises: where did their presentation take place?

(iii) *Shrines and Sacrifices*

The illustration of the + 1530 *Nung Shu* edition (Fig. 166) depicts three of the six goddesses, with Lady Hsi-ling in the centre, holding regalia in their hands. The regalia cannot be seen in the *Nung Shu* edition of + 1774 (Fig. 167), though they clearly demonstrate positions of the goddesses in the divine hierarchy. All six sit on chairs decorated with patterned fabrics which are placed on pedestals. The conjecture that all of them, including the two attendants of Lady Hsi-ling, were at least lifesize statues, is confirmed by the text in the *Nung Shu* which says that from ancient to modern times the tradition was handed down to erect statues *(li hsiang*[2]*)* and to sacrifice to them. The whole group of statues—probably made by craftsmen who modelled the figure in clay and plaster over a hollow frame—may have originally been dressed with silk garments and painted in colours.[0] The presentation and size of these statues, the cloth-covered altars with the incense burner and the sacrificial offerings, the silkworm mat and the stand with the round silkworm trays, indicate that the illustration pictures an idealised interior of a temple hall without revealing any of its architectural features. That such temples and shrines existed is evident from the silkworm temple *(tshan-kuan*[3]*)*, established in the year +460.[4] We know this from the history of the Szechwanese Tshan-tshung-tzhu[4] in the district of Chhêng-tu, founded between +483 and + 493, and from the legend of the King of Shu[5], Mr Tshan-tshung[6] in Ming and Chhing times, popularly known as the 'God of Blue Cloth' *(chhing-i-shen*[7]*)*.[e] He

[a] According to the *Chou Li,* the official in charge of horses also had a say in the rearing of silkworms; Biot (1), vol. 2, p. 190.

[6] *PFKI,* ch. 2, p. 20b; *TSTP,* ch. 11, p. 21a. Unfortunately we could not find more information about the five sericultural patron saints of Kuangtung province.

[0] We assume the goddesses were manufactured by a similar technique to that used to make the Lohans preserved in the Halls of 500 Lohans, belonging to various temples in China (see, Anon. *{638)*; clay statues are also preserved in the Chin-tzhu near Thai-yüan (see Chai Tse-Chün *(1)*; the statues could also have been executed in the lacquered clay technique as can be seen in the Hsia Hua-yen-ssu in Ta-thung (see Sekino Tadashi, Takeshima Takeuchi (/), pi. 34.

[a] *Sui Shu,* ch. 7, p. 145.

[e] *Nan Chhi Shu,* ch. 35, pp. 629-34; Werner (1), p. 83.

[1] 蠶花五聖 [2] 立像 [3] 蠶觀 [4] 蠶叢祠 [5] 蜀
[6] 蠶叢 [7] 青衣神



Fig. 169. The Shrine of the Silkworm Goddess (*tshan-ku-shen tzhu*), + 1899. *TSTP*, ch. 12, p. 9a.

taught the peasants how to rear silkworms. In + 1742 we read of a 'hall of the goddess hsien-tshan' *{hsien~tshan-shen-tien*[1]*)* in Peking which has to be seen in the context of the new sericultural ceremonial activities of emperor Kao-tsung.[a] In +1794 the cities of Hangchou[2], Chia-hsing[3] and Hu-chou[4], in Chekiang province, all maintained shrines of sericultural goddesses.[b]

That people maintained shrines to honour inventors who had helped them to improve their lives is also reported of Huang Tao-Pho[5], a skilled woman textile technician who introduced cotton technology to the Sung-chiang region about + 1290 in Yuan times.[0]

The *Tshan Sang Tshui Pien* (General Compendium on Sericulture) from + 1899 tells us[d] that in Szechwan on New Year's day, old women, as well as boys and

[a] *Chhing Shih Kao,* ch. 83, p. 2519.
« See above, ch. (</), (3).

[b] *Chhing Shih Kao,* ch. 83, p. 2521.
« *TSTP,* ch. 12, p. 9b.

[1] 先蠶神殿 [2] 杭州 [3] 嘉興 [4] 湖州 [5] 黃道婆

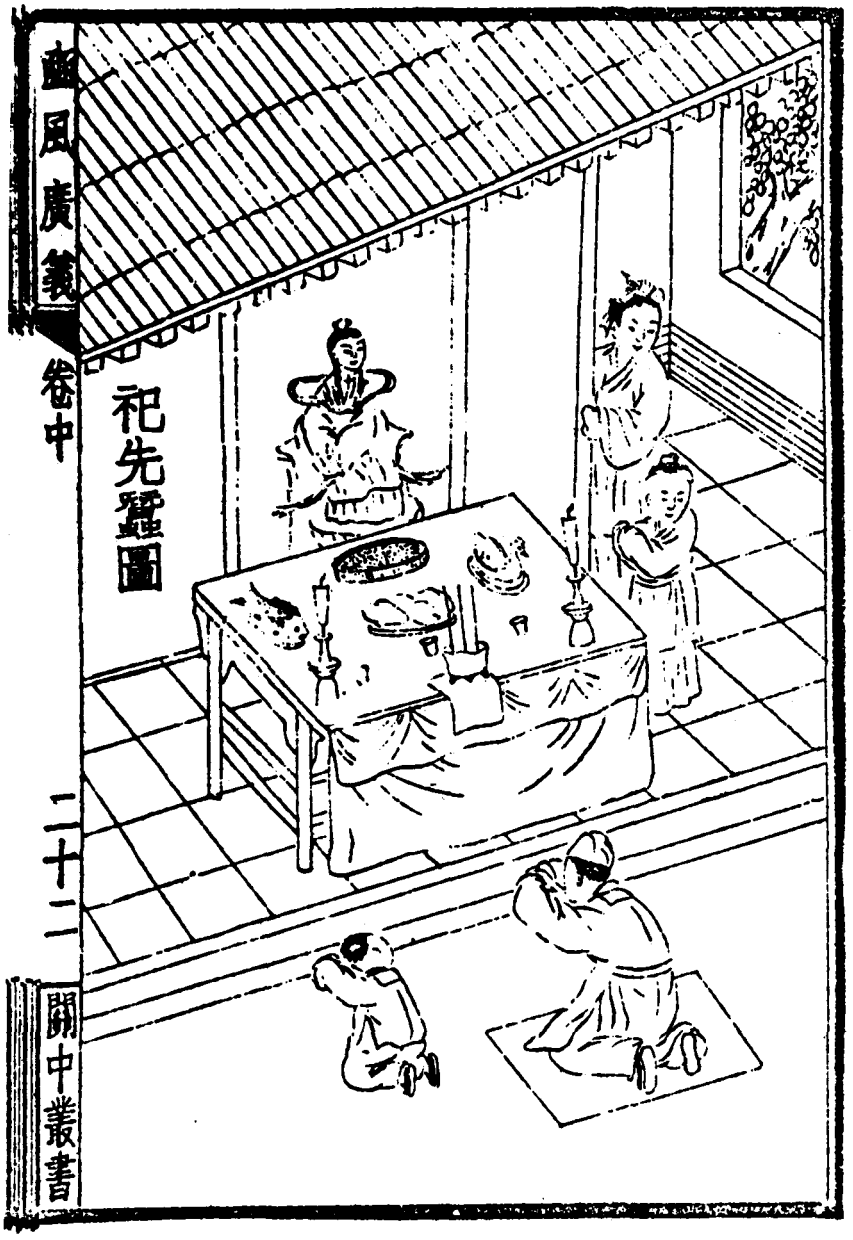


Fig. 170. Sacrificing to the First Sericulturalist (*ssu hsien-tshan*), +1742. *PFKI*, ch. 2, p. 22a.



Fig. 171. Sacrificing to the First Sericulturalist (*ssu hsien-tshan*), + 1899. *TSTP*, ch. 11, p. 22a.

girls, worshipped in the courtyard, beating a drum and exploding crackers to welcome the 'moth-eyebrowed' goddess of sericulture. They propped up the silkworm baskets so that the noise of exploding crackers could be heard, because the loudness of the explosions was taken as an omen of the size of the crop which silkworm breeders could expect. The illustration to the text (Fig. i6g)[a] depicts the shrine of the goddess *(tshan-ku*[1]*)* as a small walled compound with a hall. The inscription on the gate above the entrance says: 'Shrine of the silkworm goddess' *{tshan-ku-shen tzhu*[1]*).* In front of the gate a woman carries crackers in a kind of framed tray and the children following her are beating drums. The inscription on the banner hoisted on the flag-pole reads : ' Silkworm goddess ' *(tshan-ku).*

Apart from this obviously popular tradition in Szechwan on New Year's day, there existed two other customary sacrifices, neither confined to one province. To judge from the *Tshan Shu* off. +1090, ordinary people who reared silkworms sacrificed a fowl and wine to the First Sericulturalist, doing so on the day when the eggs were spread out on paper for the hatching sleep.[b] The *Pin Feng Kuang I*

» *TSTP*, ch. 12, p. 9a. " TO, p. 3.

[1] 蠶姑 [2] 蠶姑神祠



Fig. 172. Thank offerings (*ssu-hsieh*), + 1607. *PYHHCY*, ch. 20, p. 15a.

(Enlarged Explanations of the Sericultural Crafts of Pin) of + 174a explains this more precisely: if there were many 'ants' (t[1])—silkworms freshly emerged from their eggs—then the sacrifice consisted offish, pork, fowl and wine; if there were few, then only fowl was offered.* In any case, the silkworm breeders placed either cocoons made of rice on a dish or 'ant' silkworms on a tray on the altar.[b] This sacrifice usually took place on the veranda or in a room furnished with an altar in front of a picture (Fig. 170; Fig. 171), statue (Fig. 172) or tablet (Fig. 173) of the First Sericulturalist.[0] The verandas and rooms belonged to the breeding houses of those who bred silkworms, and probably not to shrines built specially for this purpose.

In the 'silkworm month'—the fourth month of the lunar calendar—such everyday activities as social visits, celebrations, and tax collecting stopped (the so-called 'silkworm taboos'), so as not to disturb the life rhythm of the silkworm which, in Kiangsu province, was of fundamental importance to the rural economy.[4]

The traditional thank-offerings *(ssu-hsiek[2])* to the First Sericulturalist occurred

» *PFKI*, ch. 2, p. 20b; *TSTP*, ch. 11, p. 21a.
» *PFKI*, ch. 2, p. 21a.
[c] *PFKI*, ch. 2, p. 22a; *TSTP*, ch. 11, p. 21a; *PTHHCT*, ch. 20, p. 15a, see also Kuhn (2), p. 365, Abb. 28; Franke (ii), Taf. LXXXVIII; *PFKI*, ch. 2, p. 54a.
[d] Sun (2), p. 84.

[1] 蟻 [2] 祀謝

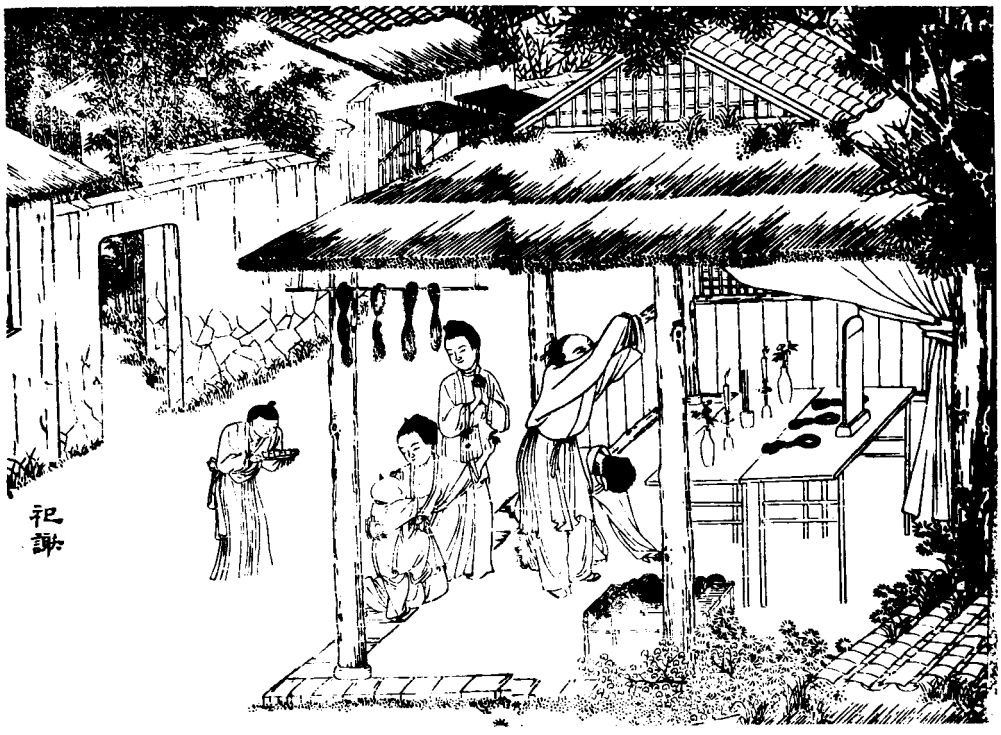


Fig. 173. Thank offerings (*ssu-hsieh*), + 1739. *KCT*, reproduced from Otto Franke (11), Taf. LXXXVIII.

in October.[0] From the illustrations still extant (Fig. 172; Fig. 174) we may conclude that the offerings on the altar table consisted of fish, pork, wine and skeins of silk.[b]

Our discussion could finish here, but for one rather embarrassing fact concerning the god(dess) which must be mentioned. All the book illustrations from the late + 16th to the late + 17th century, which are in the long tradition of the *Keng Chih Thu* (Pictures of Tilling and Weaving) or are connected with it,[c] depict either a tablet (from the back) or a male First Sericulturalist, and for reasons which are unknown to us. Strangely, the poems to the illustrations often define the First Sericulturalist as Lady Hsi-ling.[d]

The male patron saint—probably Huang-ti—is depicted with[6] or without a beard[1] but always with several arms and sometimes with as many as three swords

* *TSTP*, ch. 13, pp. 25b-26a; Franke (n), pp. 176-7, n. 96.

» *PFKI*, ch. 2, p. 54a; *PYHHCY*, ch. 20, p. 15a; *PMTT*, ch. 1, p. 14a; Franke (t 1), Taf. LXXXVIII; Pelliot (24), pi. 18.

[0] Kuhn (2), pp. 338-40, p. 347, no. 42.

[ä] ÜTCTedition (+1883), pp. i6ab; The poems by Khang-hsi (+1696) and Chhien-lung (+ i739(?)).

[e] Franke (11), Taf. LXXXVII (Japanese edition of +1676).

[1] Pelliot (24), pi. 18 (edition of +1769).

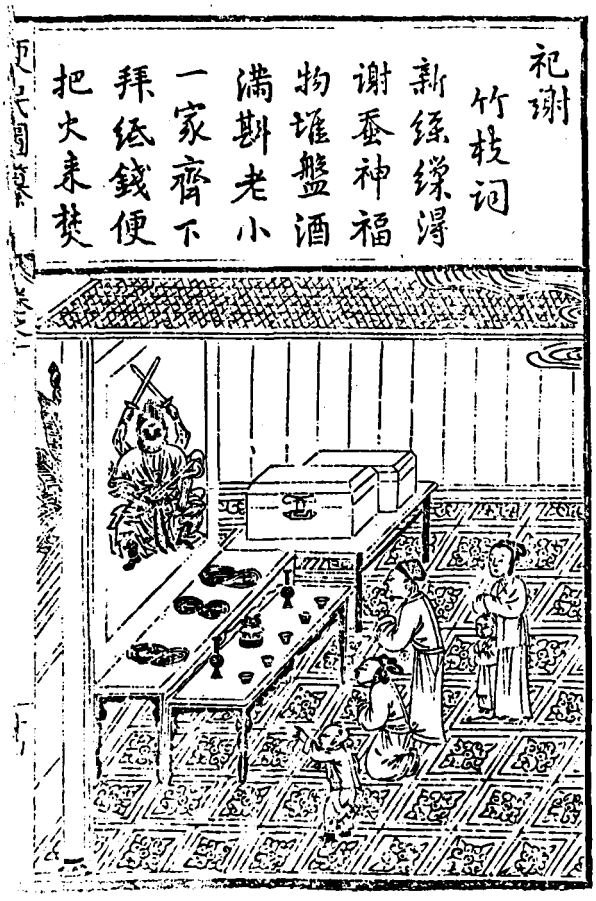


Fig. 174. Thank offerings (*ssu-hsieh*), + 1593. *PMTT*, ch. 1, p. 14a.

(Fig. 174).* He may be seen as a patron saint, but without a definite field of competence assigned to him.[b] The craftsmen, who always copied their illustrations, may often have altered the patron saint's physical appearance because they did not comprehend his or her nature. As a result, the *Keng Chih Thu* of + 1696 and all subsequently published Chinese editions, only show a tablet on the altar (Fig. 173) similar to those which were used in the ancestral cult. This orthodox solution neutralised the iconographie problem.[0]

However, the popular encyclopaedic work *Pien Yung Hsüeh Hai Chhün Til* of

[a] *PMTT*, ch. 1, p. 14a; Franke (n), Taf. LXXXVII (Japanese ed.).

[b] Exceptionally Huang-ti acted as a 'god of sericulture' in a few officially sponsored sericultural temples in + 18th century Chekiang province.

[0] Such a solution had already been taken in the past with the images of Confucius and his disciples; these were replaced in the temples by carved tablets as a result of a revision of ritual regulations which started in + 1530; see Chang Fu-Ching» (+ 1475 to + 1530) *(MB,* vol. 1, p. 69) and Hsü Chieh* (+ 1503 to + 1583) *(MB,* vol. 1, pp. 571-2).

[1] 張孚敬 [2] 徐階

+ 1607 shows a male patron saint in the form of a statue resembling a Chinese official placed on an altar[a] (Fig. 172). Obviously the use of statues was more common with the people[1]» than hanging painted scrolls, and so such popular editions constituted a compromise between reality in daily life, when people offered sacrifices to statues of female silkworm goddesses, and the honoured tradition of male patron saints handed down in those works to be copied. To judge from the sources and the research done on the *Keng Chih Tku,* the problem of its representation of the silkworm patron saint, is probably insoluble and will remain a riddle.

(2) ARCHAEOLOGICAL AND TEXTUAL EVIDENCE OF SILK

It now seems desirable to concentrate on the early—neolithic and Shang—finds of silk fragments which make it possible to draw a number of verifiable conclusions essential to understanding the place of silk in Chinese history. Knowledge in China about silk and discovery of its use held the seeds of its development by the Chinese people. The material required certain techniques which had to be invented, used and then improved, or which had been discovered by chance. It was these which provoked specific silk weaving methods.

Together with Shang pictographs and inscriptions, we gain a vivid impression of the extent to which silk constituted an essential part of material culture and influenced working conditions in the Shang silk workshops.[0] For a sound understanding of silk and its techniques of production, the beginnings of the silk industry must be stressed and something must be said about the variety of silk products, otherwise we can hardly appreciate and follow in a chronological order all the innovations subsequently made in the field.

When approaching the Chou dynasty literary sources will help to give an idea of the ways in which the manufacture of silk influenced the daily life of women in particular. This influence was intensive even in the early centuries of the — ist millennium.

(i) *Neolithic and Shang Silk Fragments*[d]

In 1958 fragments of silk were discovered in a bamboo basket in trench no. 22 at the site of Chhien-shan-yang[1], Wu-hsing[2] county in Chekiang province.[e] By the carbon-14 method this layer was dated as lying between —2850 and —2650.'

[1] *PTHHCT,* ch. 20, p. 15a.
[b] This fact can still be observed today in folk religion, for example, in Taiwan, Hongkong and Singapore.
[c] Kuhn (8), pp. 397-406.
[d] Paragraphs (/) (2) (i) and (ii) are both based on Kuhn (8), pp. 369-86.
[e] Anon. *{757),* p. 86; Cheng Te-Khun (16), pp. 36-7; Chang (1), pp. 180-1 ; Shih Hsio-Yen *(1),* p. 306; Anon. *(644),* p. 225, n. 8.
[' Barnard (6), p. 24, sample ZK-49; Chang (1), p. 487.

[1] 錢山漾 [2] 吳興

The site most probably belonged to the Liang-chu[1] culture. So far this is the earliest find of silk in China.

One silk fragment was woven in a tabby weave structure, a fabric of the *chiian*[2] type from silk of the domesticated silkworm *Bombyx mon (chia-tshan*[3]*).* The fragment measures 2.4 x 1 cm and has a thread-count of 48:48 warp-threads to weft-threads per cm.[a] Warp and weft are of equal diameter, with a Z-twist put into them. Another piece of silk has a thread-count of 72:64 per cm, both warp and weft being in an S-twist.

We see no reason to doubt the — 3rd millennium date of the silk fragments as An Chih-Mint> and Hsia Nai do. Hsia Nai[c] regards these fragments as contemporary with the Shang dynasty of north China, but just recently Chou Khuang-Ming[d] has again investigated the silk fragments and the circumstances of their excavation. He has arrived at the conclusion that the silk used is from domesticated silkworms and that there is no reason to doubt a dating in the — 3rd millennium.

Let us now turn to another neolithic find: the artificially cut half cocoon excavated in 1926 by Li Chi at the site of Hsi-yin-tshun[4], Hsia[5] county in Shansi province.[6] Generally it was regarded as a silkworm relic of the *Bombyx mori* species and dated as belonging to the Yang-shao culture, *c.* —2200 to — 1700, but Hsia Nai thinks the cocoon to be a later intrusion.[1] He wrote that in the first place, judging by the experience of archaeologists, it is rather unlikely to find a cocoon surviving in this perfect condition in a neolithic cultural layer of the north China loess belt. Secondly, he doubted whether people in the neolithic age would have a blade sharp enough to have made so clean a cut across a silkworm cocoon. But before going any further along these lines, we should inquire how, if there was no sericulture either in north or in south China in the — 3rd millennium, is it possible to explain the rather developed silk technology in the Shang period? In our opinion sericulture must have existed in north'and south China before the Shang, and this quite apart from the problem of the Chhien-shan-yang silk finds and the Hsi-yin-tshun cocoon.

Nunome Junrö,* Wan Chia-Pao,[h] Satö Taketoshi[1] and Chiang Yu-LungJ have, however, carried out research on the problem of the Hsi-yin-tshun cocoon. Perhaps, then, we should give a short abstract of the conclusions drawn by Nunome who, in our opinion, has done the most profound research into the history of silk in East Asia. In his view the cut could have been made with a thin flint fragment. He thinks that a piece of organic matter like this cocoon might survive

[a] Hsia Nai (9), p. 13.
[c] Hsia Nai (o), p. 14.
0 Li Chi (if), pp. 22-3; Chang (/), p. 95; Cheng (i8), p. 241 ; Ho Ping-Ti (5), p. 84; Li Chi (6), p. 58, p. 270, n. 6.
[8] Nunome *(6),* pp. 187-94; Nunome (/), pp. 164-74, P- [1]*§7*> [n]g- [11]-3-
" Wan Chia-Pao (/), pp. 1—17.
1 Chiang Yu-Lung *(3).*
•> An Chih-Min *(6),* pp. 40-1.
a Chou Khuang-Ming *(2),* pp. 74-7.
' Hsia Nai *(to),* p. 100.
' Satö (/), pp. 42-4.

[1] 艮渚 [2] 絹 [3] 家蠶 [4] 西陰村 [5] 夏

burial for 4000-4500 years in a region of low rainfall (the present annual precipitation at Hsi-yin village is 500 mm), yet he nevertheless regards it as astonishing.

In 1967 he obtained photographs of the cocoon fragment from the Palace Museum in Taipei and carried out further research far beyond the scope of that already done by the Smithsonian Institution in 1928. He arrived at the conclusion that the fragment was not cut in half but was more than 80 % of its original size. So its length was *c.* 1.52 cm, the widest width *c.* 0.71 cm, the colour a pale yellow-brown. This means: firstly, that because of its size the cocoon belonged neither to *Bombyx mori,* as was claimed in all previous reports, nor to *Bombyx mandarina,* but to *Rondotia menciana* Moore. *Bombyx mori* can be excluded because it is too large; *Bombyx mandarina* has the same egg-shape, but is too large as well. So it must be *Rondotia menciana* Moore.[a] At present there is no trace of this type in north China. Secondly, the portion cut away is about 17%, and most probably this was done to extract the chrysalis undamaged. It may have been used for food,[b] with the cocoon for silk-wadding or spun silk. Thirdly, though the cocoon was yellow-brown and the natural colour of *Rondotia menciana* Moore is a faint creamy yellow, the difference may have been caused by the remains lying in the ground such a long time (Fig. 194).

The discussion of the Hsi-yin-tshun cocoon shows that questioning long 'established' facts can produce most surprising results. After Nunome's research we can be certain for the time being that silk from wild spinners *(yeh-tshan[1])* as well as from the domesticated silkworm was used in the neolithic and in the Shang silk production.[0]

Most archaeologists agree that silk, hemp *{Cannabis sativa) ta-ma[2],* ramie *(Boehmeria nivea) chu-ma[3],* and *kuzu* vine *(Pueraria thunbergiana) ko[4]* were the materials used to produce fabrics of various types.[d] As far as we know, the silk fragments discovered in China and dated as being from Shang times have always been part of the wrapping material employed for bronzes and jade objects. Hence many of the silk relics are preserved as an integral part of the bronze patina which means that their organic structures have been replaced by the products of bronze corrosion. For such 'textile remains' John Vollmer coined the widely known term 'pseudomorph' (literally: false form) and it is now generally accepted® Regrettably, it is often impossible to decide from the texts in Chinese publications whether traces or pseudomorphs are being described and discussed. Chinese scholars mostly use the term *hen-chi[5],* meaning mark, trace, or track for both of them.

[a] Moore (i), pp. 491-2; Pariset (1), pp. 57-60; Fauvel (1), pp. 100-10; Omura (/), pp. 79-130.
[b] Bodenheimer (1).
[c] Nunome (/), pp. 190-4, p. 193, fig. ia-i; plates 12-9, 12-10, 12-11.
[d] Chang (1), p. 289; Cheng (18), p. 196; Li Chi (6), p. 208.
[e] Vollmer (1), p. 170: 'Technically the term describes mineralogical phenomena in which crystals consisting of one mineral take the form proper to another. On the Chinese bronzes studied, the surface of the textile touching the object has been wholly surrounded by the products of corrosion resulting in a negative pseudomorph, or replaced by these corrosion products yielding a positive or true pseudomoroph.'

[1] 野蠶 [2] 大麻 [3] 苧麻 [4] 葛 [5] 痕迹(跡)

In 1972 Hsia Nai suggested that certain weaving techniques already existed in Shang times basing his statement on archaeological finds.[a] Research since 1972 allows Hsia's inventory of techniques to be augmented.

1. Tabby weaves *(phing-wen tsu-chih[1])* with threads of almost identical diameter and a thread-count of warp and weft between 8:7 to 75:50 per cm.[b]
2. Warp-faced tabby,[0] also called rep or rib *{ching-chhi-wen ti phing-wen tsu-chih[2])* where the number of warp-threads is roughly double the number of weft-threads per cm, 72:35 per cm and 40:17 per cm. Many samples range above the 30:20 per cm standard.[d]
3. Monochrome tabby patterned with twill 3/1 *(wen-chhi[3]),*[e] very often named twill damask.' The ground weave is a tabby weave, the pattern is woven in 3/1 twill weave with the warp-threads forming the pattern. The fabrics may have originally been monochrome red, brown, blue or any other colour which dissolved and faded away in the three to four millennia since they were buried in Shang tombs.
4. Tabby crêpe *(chou[4]* or *hu[s])* with a thread-count of *c.* 30:30 per cm. The silk warp-threads show a Z-twist with 2500 to 3000 twists per m. The silk weft-threads are twisted together from several threads in an S-twist showing 2100 to 2500 twists per m. The strong twisting of the threads causes the crêpe-effect.[g]
5. Most probably the crossed-warp weave technology *(chiao-ska tsu-chih[6])* was known and used.[h]

As John Vollmer has also shown in his study* there is reason to believe that cultivated silk from domesticated silkworms was used to weave silk fabrics. Spun silk from wild spinners may have been produced as well for other items, or the unspun fibre material may have served as padding material in silk winter garments. Twisting technology was known and applied by the Shang craftsmen, while grège silk' *(sheng-ssu[7])* was used for embroidery to get a bright effect. Poil[k] *(jung-thou-ssu*)* with a slight twist was taken for the edging of rhomboid *[ling[9])* and zigzag-weave patterns *(che-chiao po-lang-wen[10]).*

[a] Hsia (9), p. 14; Shih Hsio-Yen (1), p. 306. [b] Vollmer (1), p. 172.
[c] This term has been taken from Irene Emery (1), p. 76, fig. 86.
[d] Vollmer (1), p. 172.
[e] The monochrome tabby patterned with twill must be distinguished from the tabby patterned with warp-floats in every other warp-thread, the so-called *Han-chhi",*as already done by Hsia (9), p. 19; see also Hsia Nai *{8),* pp. 48-50. ' Sylwan (2), p. 122.
[8] Wang Jo-Yü (/), p. 49; Kao Han-Yu (/), pp. 47-8. *> *Ibid.*
[1] Vollmer (1), p. 172.
i *GTL,* vol. 2, p. 360. Grège is defined as reeled untwisted silk consisting of 3 to 8 cocoon filaments, still surrounded by the sericin so that the filaments adhere together.
[k] Anon. (760), p. 359. Poil is a grège thread consisting of the filaments of 8 to 12 cocoons; *GTL,* vol. 2, p. 360 defines it differently: poil is a grège thread showing *c.* 2000 twists per metre put into it, both for warp and weft alike.

[1] 平紋組織 [2] 經畦紋的平紋組織 [3] 紋綺 [4] 縐
[5] 縠 [6] 絞紗組織 [7] 生絲 [8] 絨頭絲
[9] 菱 [10] 折角波浪紋 [11] 漢綺

The most famous surviving silk fragments are the pieces of silk adhering to the patina on a bronze wine vessel *(chih[1])*, preserved in the Malmö Museum (Inv. no. 27.215) and to a bronze axe *(jiieh[2])* in the Museum of Far Eastern Antiquities, Stockholm (Inv. no. K. 11090:36) which have been examined by Vivi Sylwan[a] and a few years ago by Nunome Junrô.[b] The result of Vivi Sylwan's study was an outstanding contribution to the understanding of the textile history of China, though the fragments, which are only traces, have often been discussed and illustrated in other scholarly publications.[0]

Surface examination of the *yiieh* has shown that the silk was of three types. One was made up of two strands twisted together of a rather good quality silk in a loose Z-twist. Taken together the two-strand thread was 0.04 cm in diameter. A second consists of a rather coarse Z-twisted quality, perhaps spun from a wild silkworm. The third type of thread had no twist at all. The thickness of the plain weave silk woven in a loose flat tabby was 0.055-0.065 cm; the thickness of the twill weave which was an under-one over-one and under-one over-three twill was 0.075-0.080 cm. The density of the weave varied considerably between 37 to 50 warp-threads per cm and 30 to 35 weft-threads per cm. The silk may have been pulled out of shape.

As far as the small wine vessel *chih* is concerned, this also shows several different kinds of silk. The untwisted silk thread is silk obtained from the domestic silkworm reeled off in hot water or steam, and its weave is both tabby and twill. The tabby has 72 warp-threads and 35 weft-threads per cm, the coarser one 40 to 17 per cm. There is also a twill similar to the one described above but not joined to the tabby. Nunome has shown not only that the textile traces on the *chih* consist of silk from the domestic silkworm but also that there are small quantities of wool and plant fibres and of silk fibres from the oak-silk spinner *(tso-tshan[3])*.

These famous silk fragments have been subjected to microscopic examination which has revealed that the fibres from both bronzes have cross-sections smaller than any other known in history.[4] As regards the source of the silk, Nunome concluded that the domestic silkworm was cultivated in Shang times but that the breeds had not then been greatly improved and could not yet produce the optimum quality of fibre.

Nunome's count of tabby weave is 67:30 per cm. This is very close to Sylwan's figure of 72:35 per cm.

In a later investigation Vivi Sylwan detected traces of embroidery on the Malmö *chih* which she described as 'silk embroidery in satin-stitch with small remains of what was possibly chain-stitch'.[e]

[a] Sylwan (i), pp. 19-21, figs. 1-10; Sylwan (2), pis. 1-4.
[b] Nunome *(4)*, Nunome *(1)*, pp. 190-5, pi. 12-9, 12-10, 12-11.
[c] Willetts (1), pp. 136-7; Hsia Nai (9), p. 12; Satö (/), pp. 90-4.
[A] Nunome (1), pp. 192-5; Satö (7), p. 93.
[e] Sylwan (4), p. 119.

[1] 鱓 [2] 鉞 [3] 柞蠶

A number of bronzes with textile traces and pseudomorphs were excavated in the twenties, thirties and fifties. Unfortunately they did not receive the same attention and so we can only give rather scanty information. Mostly the textile relics are described as of *pu-wen*[1] cloth-pattern. This normally means plant fibre cloth. We understand it here as a pattern resembling tabby cloth which does not indicate the raw material the fabric was made of.

In 1929 at the third excavation at the Yin[2] site of Hsiao-thun[3] tomb no. 18.2, a weapon resembling a dagger *ko** was discovered ' on which a textile pattern could be discerned very clearly '.[a] In 1934-5 during the tenth and eleventh excavations at Hou-chia-chuang[5] in the large tomb KPKM 1001, a bronze *chiieh*[6,h] a h ' [c] and a dagger £o[8d] were found. On their surfaces, apart from mat and other unidentifiable textile patterns, traces of a sort of fine fabric of silk cloth were found. The large tomb at Wu-kuan-tshun", An-yang, excavated in 1950 yielded three bronze daggers *(ko'°)* with traces of silk cloth and feather adhesions,[e] and in 1955 a bronze basin *{phen*[11]*)* with textile traces was found at Cheng-chou.[f] Yet another basin with silk traces dated as belonging to the Shang period is preserved in the Ku-kung po-wu-yüan, Palace Museum Peking.[8]

In 1973 and 1974 the Shang site of Thai-hsi-tshun[12] at Kao-chheng[13] **in Hopei** was excavated. Apart from hemp relics, silk remains have been found on wine vessels of the *ku*[l]* and *chiieh*[li] type and on the surface of a dagger (^o[16])? In tomb no. 38 five fragments of fibre material were found adhering to a bronze *ku* (Table 4). In structure these fragments very much resemble silk.[1]

Table 4. *Structure of the Five Damaged Silk Fragments**

No.	Weave structure	Thread-count warp : weft/cm	Width in mm of Warp	Weft
1	Tabby	45 = 30	0.2	0.4
2	Tabby	24:21	0-3	**o-5**
3	Tabby	15:12	0.1	0.1
4	Crossed warp-weave	36:27	0 3	0.4
5	Tabby-crêpe	30-35:30	0.1	0-3

The samples 1 and 2 do not reveal anything new.

[a] Li Chi (/), p. 466, tomb no. x8.2, pi. 5: 3; Hu Hou-Hsüan *(8),* p. 3.
[b] Liang Ssu-Yung (/), vol. 1, pp. 310-11, R 1068, pi. 242: 4.
[0] Liang Ssu-Yung (/), p. 325, R 5063, pi. 253: 3. a *Bid.,* p. 319, R 6872, pi. 248: 15.
[e] Kuo Pao-Chün *(3),* pp. 17-19; Menzies (2), pp. 45, 174, 231-2.
['] Hsü Shun-Chan (/), p. 18. g Wang Jo-Yü *(3).*
[»] Wang Jo-Yü (/), p. 49. 1 Kao Han-Yu (/), pp. 46-8; p. 46, fig. 6.
[i] Wang Jo-Yü (/), p. 49, n. 8.

[1] 布紋 [2] 殷 [3] 小屯 [4] 戈 [5] 侯家庄 [6] 爵
[7] 觚 [8] 戈 [9] 武官村 [10] 戈 [11] 盆
[12] 台西村 [13] 藁城 [14] 觚 [15] 爵 [16] 戈

Sample 3 is described as a tabby weave in an open structure, called *sha*[1].

Sample 4 was woven most probably by the crossed-warp weave technique *{chiao-sha tsu-chih*[2]*).* Chinese scholars explain it as a type of gauze *(sha-lo**).*

Sample 5 is the most interesting fragment. It is a very regularly woven fabric. Two silk warp-threads are twisted together into a Z-twist having 2500 to 3000 twists per m. In the weft, too, several threads are twisted together in a S-twist showing 2100 to 2500 twists per m. These silk threads are all rather strongly twisted, so much so that it gives rise to a crêpe-effect, which may be described here as a tendency of the threads to curl *(wan-chhii*[4]*)* and shrink (JO[5]) in both warp and weft.[a] Hence they are crêpe-threads *(chou-sha*[6]*).* The sample is the earliest surviving evidence of this type of fabric.

Textile impressions *(yin-hen*[1]*)* of hemp and silk have been found on a jade dagger which is preserved in the Ku-kung chih-hsiu-kuan[8] at Peking.[b] It resembles those found in 1953 and 1958 at the site of Ta-ssu-khung-tshun[9].[c] This Peking dagger is 22.2 cm long, 4.7 cm wide, and its handle has a width of 3.8 cm. On the front side of the handle traces have been discovered which can be described as a cloud pattern *{lei-wen*[10]*),*executed in monochrome tabby patterned with twill, in which the ground structure is tabby and a four bind twill makes the cloud pattern. Surprisingly enough, there is no recognisable twist in the silk threads of warp and weft although their diameter is 0.7 mm. The thread-count is 20:16 per cm.

On the handle of a bronze dagger *(thung-ko-pa*[11]*)* which is preserved in the Ku-kung po-wu-yiian[12] several traces of silk were found.[d] Once more the ground weave shows a tabby structure; the patterns were executed in two types oftwill. The threads, which are not twisted, have a diameter of 0.25-0.30 mm. The thread-count is 20:30 per cm.

(ii) *Shang Pictographs and Inscriptions*

It is still an extremely difficult task to explain Chinese pictographs. We are not specialists in this field, so we have to rely on the sources available to us and the interpretations suggested by a number of Chinese and Japanese scholars.

Wen I-To distinguished five different usages of the pictograph *sang*[li]*{*¥\g. 175.1), 'mulberry tree':[e] firstly, mulberry grove *(sang-lin*[1]**) ;* secondly, mulberry tree *{sang-*ma's) ; thirdly, a place-name *(ti-ming*[lf]*>)* ; fourthly, a verb, to gather mulberry leaves *(tshai sang*[r7]*)* ; fifthly, a borrowing for *sang*[1]**,* to die.

» *GTL,* vol. 1, p. 738.
[b] Chhen Chüan-Chüan *(i),* pp. 70-1.
[c] Ma Te-Chih *(1),* p. 56, pi. 19; Anon. *(692),* p. 57.
[d] Chhen Chüan-Chüan (/), p. 71, figs. 5-7.
[e] Wen I-To *{4),* vol. 2, pp. 565-70; Satö (;), p. 55; Nunome *(1),* pp. 186-7.

[1] 紗 [2] 絞紗組織 [3] 紗羅 [4] 彎曲 [5] 縮
[6] 縐紗 [7] 印痕 [8] 故宮織綉館 [9] 大司空村 [10] 雷紋
[11] 銅戈把 [12] 故宮博物院 [13] 桑 [14] 桑林 [15] 桑木
[16] 地名 [17] 採桑 [18] 喪



1 *sang*

1 *hsü* 3.31.9
Sun, p. 269



2 *chhien* 4.41.4
Sun, p. 269
Nunome (*1*), fig. 12–5B



3 *chhien* 5.53.7
Wen, p. 565
Nunome (*1*), fig. 12–5D



4 *chhien* 4.47.1
Wen, p. 565
Nunome (*1*), fig. 12–5E



2 *tshan*

1 *hou* 1.28.6
Yeh, 6: 56b
Nunome (*1*), fig. 12–1B



2 *Wen*, p. 571



3 *Nan*, no. 468
Satō (*1*), p. 49E



3 *ssu*

1 *hou* 2.8.7
Chu, 13: 2a
Lo, 2: 42a
Nunome (*1*), fig. 12–7G
Sun, p. 507



2 *hou* 2.8.6



4 *po*

1 *chhien* 2.12.4
Sun, p. 336
Nunome (*1*), fig. 12–7K



5 *shu*

1 *chia* 430
Sun, p. 275



2 *Sun*, p. 275



6 *i*

1 *Lo*, 2: 42b



2 *Lo*, 2: 42b



7 *ssu*

1 *Sun*, p. 505
Nunome (*1*), fig. 12–7E



2 *Lo*, 2: 42a
Nunome (*1*), fig. 12–7C



8 *hsi*

1 *chia* 3510
Sun, p. 503

Fig. 175. Pictographs relating to sericulture and silk technology, Shang dynasty. (Key to the generally used abbreviations for works dealing with oracle-bone pictographs): *chia*—Tung Tso-Pin (*12*); *chhien*—Lo Chen-Yü (*4*); *Ching-chin*—Hu Hou-Hsüan (*6*); *hou*—Lo Chen-Yü (*6*); *hsü*—Lo Chen-Yü (*8*); *tshui*—Kuo Mo-Jo (*14*); *Chu*—Chu Fang-Phu (*1*); *Lo*—Lo Chen-Yü (*7*); *Ming*—Ming I-Shih (*1*); *Nan*—Hu Hou-Hsüan (*7*); *Sun*—Sun Hai-Po (*1*); *Wen*—Wen I-To (*4*); *Yeh*—Yeh Yü-Sen (*1*).

Several scholars have shown in their publications pictographs which can be interpreted as silkworms *{tshan* '),[a] though others would rather prefer to explain them as insects *(chhung[2])* generally, not any particular kind.[b] We follow the opinion of Sato Taketoshi that silkworms are pictured, but we doubt whether various species of silkworms were depicted on the bones on purpose as Nunome suggested.[0] Satö has shown that insect was generally written differently,[d] and that in the case of a silkworm-interpretation all 'horizontal' lines can be interpreted as segmental divisions.

In this context, one piece of turtle plastron attracted special attention.[6] The worm-like figure on the upper half was often thought to be the silkworm pictograph *tshan.*[1] Shirakawa Shizuka[8] interpreted it as a snake spirit. Because of the fact that the lower half of the plastron shows a hand holding a leaf, Shirakawa concluded that it depicts a hand with a diviner's rod striking the snake spirit. Nunome, however, explained the matter quite differently. He takes this leaf for the five-lobed leaf of the *kurayamaguwa,* also called the white mulberry *(shiroguwa[3]).* The four dots on the surface of the leaf he explains as either the domestic or the wild silkworm *pai-yen-tshan[4], Rondotia menciana* Moore. The wild silkworm is more likely because the domestic one rarely forms more than one cocoon on each leaf. Three or four cocoons of the *Rondotia menciana* Moore are quite conceivable and have been observed. So we may conclude that besides cultivating the domestic silkworm, gathering wild silkworms was also practised under the Shang.

There is yet another angle from which to approach the question of the 'silkworm' and that is to regard it as an object of art, made in jade or some other material.[11] Generally we should doubt whether representations of those insects normally called silkworms were really meant to be so. We would rather prefer to regard them as cicadas, and this for several reasons. Firstly, the eyes of the insects represented often protrude, whereas silkworm eyes can hardly be discerned except microscopically. Secondly, most of the so-called silkworms are rather fat and very often divided into about seven segments, yet real silkworms are not fat and have more than seven segments.[1] Taking such points into consideration, we are rather inclined to dismiss the interpretation of'jade silkworms' as Shang representations of these insects.[3]

In the opinion of Hu Hou-Hsüan who did profound research on Chinese

[a] Yeh (/), ch. 6, p. 56b; Wen I-To *(4),* vol. 2, pp. 565-72, esp. p. 571 *shih-sang[5];* Satö (/), p. 49; Nunome (/), p. 179, fig. ia-i.

[b] Sun Hai-Po (/), p. 876, no. 5023. In the first edition Sun considered the insect as having the shape of a silkworm (1934 edition, ch. 13, p. 2a). Chu Fang-Phu (/), ch. 13. p. 2b. The various opinions are discussed by Ikeda Suetoshi (/), pp. 131-3.

[c] Nunome (/), p. 8, n. 2. a Satö (1), p. 50.

[e] Tung Tso-Pin *(13),* no. 451 ; Li Ya-Nung (/), p. 46.

' Just recently this interpretation was given by Chou Shih-Jung (/), pp. 566-7, fig. 2.

[g] Shirakawa Shizuka (/), p. 37.

[b] See the excellent list of literature on 'jade silkworms' by Nunome (/), pp. 359-60.

[1] Sato (/), pp. 56-7. *I* Hu Hou-Hsüan (S), p. 4.

[1] 蠶 [2] 蟲 [3] 白桑 [4] 白眼蠶 [5] 釋桑

oracle-bones, there are several pictographs which can be considered as being connected with sericulture or with silk products*: *sang*[1] (Fig. 175.1), the mulberry tree, *tshan*[2] (Fig. 175.2), silkworm, *ssu*[3] (Fig. 175.3), [su]k [an<]^ silk threads, *po*[4b] (Fig. 175.4), 'silk fabric', *shu*[5] (Fig. 175.5), a hank of silk, *i*[6] (Fig. 175.6) and *chin*,[7] things made of silk.

Though the outlines of the characters are depicted this does not mean that all of them have been used in the sense just given. However, the pictographs do document the origin of the later Chinese characters.

There is a large number of pictographs containing one of the aforementioned graphs as components. For example *i*[8] appears with 21 other graphs, JA« «with forty-six. The character *ssu*[10], generally understood as silk, can be distinguished in three forms: firstly, w«"(Fig. 175.7),(sometimes ^° [rea<]^ A«[120] (Fig. 175.8)), forms part of the composition of 81 characters, while wa[13d](Fig. 175.3) is part of the composition of 16 characters, and III appears in the composition of three characters.

Silk threads were used for fishing, most probably also for catching birds and other small animals with nets. But not all the characters with a silk component necessarily refer to silk or silk textiles. Hsia Nai[e] has pointed out that the pictograph *ssu*[14] is composed of two elements and it is undecided whether in Shang times its meaning was limited to 'thread from the silkworm'; certainly in later times characters with the element *ssu*[15] represent objects or activities connected with textiles and textile technology.

Lo Chen-Yü interpreted *ssu*[IS] as silk.* The graph is a pictogram of a hank of silk, wound in an 8-shape as was the practice in Han times[8] and later, and as can still be observed today. The protruding ends of the hank are often explained as the ends of the thread, but this interpretation is not broad enough, simply because the ends are almost invisible. We would rather suggest that these so-called ends represented the two or three filaments (from two or three cocoons) which were reeled into one thread; thus showing this characteristic feature of a silk thread as composed of several filaments. Moreover, the fully-reeled thread would be taken off the silk-reel as a hank or skein of silk. This would explain why it was possible to depict the three filaments at the top and at the bottom of the 8-shaped skein. The pictograph, therefore, shows not only the composition of a silk thread but also represents a hank of silk with its beginning and end.

» Hu Hou-Hsiian *(8),* pp. 4-6. He based his work on the research done by Sun Hai-po (/), pp. 505-7, 269, 336 and Shima Kunio (2).

[b] As has already been pointed out in other publications, the pictograph *po*[6] can only be explained as a place-name in Shang times: Sun Hai-Po *(1),* p. 336, no. 0983; Lo (7), 2.12.4.

[c] Karlgren (1), p. 232, no. 876a-b. [d] *Ibid.,* p. 257, no. 974a-c.

[e] Hsia Nai (p), p. 13.

[f] Lo (7), vol. 46, p. 529; edition of 1927, eh.- 2, p. 42a.

[g] See above, Fig. 104.

[1] 桑 [2] 蠶 [3] 絲 [4] 帛 [5] 束
[6] 衣 [7] 巾 [8] 衣 [9] 束 [10] 絲
[11] 糸 [12] 系 [13] 絲 [14] 絲 [15] 糸
[16] 帛

In conclusion, it seems safe to say that the graph *ssu*[1] originally meant silk thread and that the graph *ssu*[2] showed two skeins of silk thread. The Chinese script itself, then, provides possible evidence of the early importance of silk. So do divinatory inscriptions.

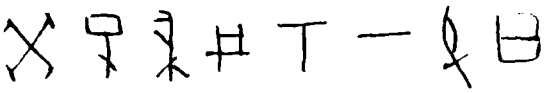
After having tried to interpret a few inscriptions on oracle-bones we should like to discuss the origin of the character *thun*[3], which most probably had to do with Shang textiles. Yü Hsing-Wu[a] suggested that *thun** is the oldest pictograph for *thun*[5] which changed in the bronze inscriptions to ^, ^. As has been shown[b] several bronzes of the Western Chou period report of" *hsüan-i-chih-thun*[6]', black robes and embroidered silks. Only in the Spring and Autumn period and during the Warring States did the *thun* get an additional silk character *ssu*[7] attached to its left side to mark it precisely as a graph which is connected with silk textiles. *Thun*[8] was used in the sense of tying up a bundle of textile material *(thun-shu*[9]*),* and use of *thun* in the sense of a roll of silk fabric is well illustrated in the *Shih Chi* in the biography of Su Chhin[10] from the —4th century. The example reads[0] *chin-hsiu chhien-thun*[11], 'polychrome silks and embroidered silks 1000 rolls'. In the commentaries, *thun* is explained *as phi*[12] or *tuan*[13], and as *shu*[14].

According to Chinese scholars we may regard *thun*[15] as the earliest character meaning 'a roll of silk fabric'.[0] In their opinion *shih-thun*[16] should be interpreted as 'to give rolls of silk as present, to bestow silk on somebody'. Forty-four Shang oracle-bone inscriptions[6] contain *shih-thun* 1/=¾¾ fg (Fig. 176).

Though it may well have been the case that members of the royal household gave rolls of silk as presents to loyal supporters of the ruling class, there is some doubt whether the two pictographs in this combination can really be understood in this way. As Keightley[f] has pointed out, the meaning of the verb T was much debated and to translate it as ' to give as a present or to bestow ' would be in his opinion rather unfortunate. He sees very little likelihood that Wang Jo-Yii is right in thinking that *À* as it appears in the marginal notations on the oracle-bones could have meant 'rolls of silk'. He thinks thatT^ meant 'to prepare the shells ritually', though there is no doubt that the T could have meant 'to offer them to the spirits '. In his opinion there seems to be no reason for thinking that the Shang diviners would consistently have recorded at a standard place on the shells and bones, and in standardised language, the arrival of rolls of silk and absolutely

» Yü Hsing-Wu *(2),* pp. 85-8.
[b] Wang Jo-Yii (/), p. 50. Yü Hsing-Wu (2), pp. 86-7.
[c] *Shih Chi,* ch. 69, p. 2250.
[a] Yü Hsing-Wu *(2),* pp. 86-7.
[e] Shima Kunio *(s),* p. 483.
' David N. Keightley (2), pp. 16-17; p. 16, n. 65; p. 17, n. 74.

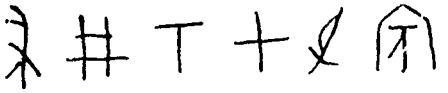
[1] 糸 [2] 絲 [3] 屯 [4] 𠂤 [5] 屯
[6] 玄衣裳屯 [7] 糸 [8] 純 [9] 純束 [10] 蘇秦
[11] 錦繡千純 [12] 匹 [13] 端 [14] 束 [15] 屯
[16] 示屯

1 

Day kuei-tzu, the consort Ching gave one roll of silk.
(Recorded by) Hsüan.
(*kuei-tzu fu ching shih i thun. hsüan*[1]).
(Fig. 176.1).[a]

2 

Day chi-hai, the consort Phang gave two rolls of silk.
(Recorded by) Pin.
(*chi-hai fu phang shih erh thun. pin*[2]).
(Fig. 176.2).[b]

3 

The consort Ching gave seven rolls of silk.
(Recorded by) Pin.
(*fu ching shih chhi thun. pin*[3]).
(Fig. 176.3).[c]







4 5 6

Fig. 176. Oracle-bone inscriptions relating to silk, Shang dynasty. 1 (4), Wang Hsiang (*1*), p. 6a, no. 41. 2 (5), Wang Hsiang (*1*), p. 6a, no. 42; Shima Kunio (*2*), p. 276. 3 (6), Lo Chen-Yü (*8*), 4.26.7; Ming I-Shih (*1*), no. 2331; Shima Kunio (*2*), p. 276.

[a] Wang Hsiang (*1*), p. 6a, no. 41.
[b] *Ibid.*, p. 6a, no. 42; Shima Kunio (2), p. 276.
[c] Lo Chen-Yü (5), 4.26.7; Ming I-Shih (1), no. 2331 ; Shima Kunio (2), p. 276.

[1] 癸子婦井示一屯亘 [2] 己亥婦龐示二屯賓 [3] 婦井示七屯賓

nothing else. He says that it seems far more likely that the standard interpretation is correct—these are records of bone and shell receipts.*[1]

Although it is too early to come to a final decision, we follow here the Chinese suggestion of translating *shih-thun* as 'to give a roll of silk'. To scholars of Shang inscriptions, this tentative interpretation may be nothing else than guesswork, but based on the Chinese interpretation of the character *thun*[1], the theoretical explanation of / gains practical value. The standard interpretation / has one shortcoming: it is very theoretical. Certainly future research will throw light on the matter.

All the evidence and the conclusions drawn from it clearly indicate[b] that silk fabrics, of which so far only 'traces' have been discovered, constituted one of the outstanding and unique achievements in material culture during the Shang dynasty. Fortunately these traces and pseudomorphs are enough to allow us to interpret many details of silk production by the Shang Chinese,[0] such as, for example, a high degree of specialisation in the workshops which needed a workforce with experience and well-trained administrators. Indeed, among the many tasks which display the complexity of this silk technology, we can distinguish the

basic tasks	cultivating mulberry plants and silkworms;
preparatory tasks	silk-reeling, spinning of waste silk, twisting and doubling;
main tasks I	degumming, dyeing, warping, dressing;
main tasks II	weaving;
final tasks	finishing.

We shall now continue here our study of silk in Chinese history with these basic tasks, followed by the preparatory tasks.

[a] Private communication: David N. Keightley's letter of 19 September 1980.
[6] The conclusions are discussed in Kuhn (8), pp. 403-6.
[0] The production is discussed in Kuhn (8), pp. 388-403.

[1] 屯

(g) THE PRODUCTION OF SILK

Before we can investigate methods of silk-reeling—how to obtain silk fibres from cocoons—several other preliminaries of silk production, such as the cultivation of mulberry trees and the various types of silkworms, deserve our attention and brief descriptive treatment.

Two items—mulberry trees and silkworms—should help us appreciate the economic importance of sericulture to a peasant community, and may also provide us with a clue to the development and geographical distribution of silk-making activities. In discussing these, we shall confine ourselves to essentials, because a study in depth would need the expert knowledge of botanists and zoologists with a good deal of working experience, and a thorough grounding in evolutionary theory. The scope of our descriptions must, therefore, be strictly limited.

Like all aspects of sericulture, planting mulberry trees, the leaves of which are used for feeding silkworms, was closely connected with Chinese policies for taxing households. In consequence, we have to consider it as a fundamental link in the chain of activities which leads finally to the production of silk fabric. It will be convenient, then, to begin by giving examples of this.

As early as — 594 a tax based on acreage of land was instituted in the state of Lu.[a] In the Mencius classic we read:[b]

> Mencius said, 'There are the exactions of hempen cloth and silk, of grain, and of personal service.. . The prince requires but one of these at a time, deferring the other two. If he requires two of them at once, then the people die of hunger. If he requires the three at once, then fathers and sons are separated.'

From various sources" we may conclude that ordinary farmers in Chou times paid their taxes in grain, cloth and in the form of labour service. This concept of tax payment in kind, the 'system of two taxes' *(liang-shui-fa*[1]*)* which originated in + 780, prevailed throughout Chinese medieval and 'renaissance'[d] history up to the + 16th century,[e] when in + 1581 the 'single whip system' *(i-thiao-pien-fa*[2]*)* came into use on a nation-wide basis.' The old system demanded two payments, one half in the summer and the other half in the autumn. The new tax system merged taxes and levies into one combined annual tax paid in silver.

Due to social developments, especially the change in demographic structure in north China, as early as +485 emperor Hsiao-wen[3] (+471 to +499) of the

• *Chhun Chhiu Tso Chuan Cheng I,* ch. 24, p. 1888 ; Hsü Chung-Shu (1), p. 8 ; Wu Chhi-Chhang (1), p. 76 ; Hsü Cho-Yün (3), p. :08.

[b] Legge (3), VII: 2: 27.

[c] See also Dubs (7), p. 126; Forke (13), p. 238.

[d] We here use the term in the sense adopted by Jacques Gernet (5), pp. 297-8.

[e] Franke, Trauzettel (1), p. 174.

' *MB,* vol. 1, p. 59 (Chang Chii-Cheng); pp. 474-5 (Haijui); vol. 2, p. 1113 (Phang Shang-Pheng).

[1] 兩稅法 [2] 一條鞭法 [3] 孝文

Northern Wei dynasty decreed the 'equalisation of land' *(chiin-thien[1])* reform,* an equal land allocation system.

This decree championed the interests of the common people, proclaimed the priority of the poor in the allocation of land, thus theoretically enabling every man to obtain a fixed acreage for himself and the various members of his family. Land allocation was handled differently in various dynasties. In Northern Wei times every man between 15 and 70 received 20 *mou (c.* 14,000 m^2) as a hereditary holding *{yung-yeh[2])* ; they were called mulberry fields *(sang-thien[3])* ; in addition arable land, the so-called dew fields *(lu-thien[4]),* were granted as non-permanent holdings, and considered as a personal share. A male person received forty *mou,* women half the amount, while children, slaves and cattle were taken into consideration as well.[b]

The Sui dynasty inherited the system with modifications,[0] while in +735 during the Thang, the *chiin-thien* system as the legal basis for all tenure of land had to be re-imposed by an edict because the expectations of the government had not been fulfilled.[4] By Thang times in fact, the system had run into difficulties, partly because the nobility found it possible to evade the regulations legally and accumulate large land holdings, while in north China there was not enough land to satisfy all those entitled to it.

But quite apart from all the economic and social problems of the equal land allocation system, naming the hereditary holdings 'mulberry fields', clearly indicates the original importance of silkworm breeding as a source of income in rural households. Indeed, regulations existed concerning the planting of such trees. In the *Yuan Shih* (History of the Yuan (Mongol) Dynasty [+1206 to +1367]) we read:[6]

Each male adult is to plant twenty mulberry (or) jujube trees each year. If the quality of the land is not suitable, then it is permitted to plant elms (or) willows...

In the second year of the reign period Chih-ta[5] (+ 1309) of the emperor Wu-tsung[6], the official Miao Hao-Chhien[7] presented the government with a plan for planting mulberry trees; he suggested that[f]

at the (appropriate) time, mulberry seeds should be gathered, and planted (later) in accordance with (practised) methods.

The emperor Wu-tsung approved this proposal and interestingly enough old agricultural works like the *Chhi Min Tao Shu* were consulted to put the planting

[a] See Balazs (n), pp. 107-9; Franke, Trauzettel (i), p. 130.
[b] *Wei Shu,* ch. 1io, p. 8853. For more detailed information on the system of equal land allotments in medieval times, see Sun and de Francis (1), pp. 158-68. [c] Wright (9), p. 93.
[a] On the land system, see Twitchett (4), pp. 1-6.
[e] *Titan Shik,* ch. 93, p. 3355; Schurmann (1), p. 52.
['] *Yuan Shih,* ch. 93, p. 2356; Schurmann (1), p. 55.

[1] 均田 [2] 永業 [3] 桑田 [4] 露田 [5] 至大
[6] 武宗 [7] 苗好謙

into effect. As this enactment produced good results, it was taken as a model and introduced to all other areas of the realm."

In the eleventh month of the year [+131310 +1314] (the government) ordered each *she*' (unit of fifty households) to prepare land for the joint planting of mulberry tree sprouts *(sang-miao[2]),* with the unit-leaders being in charge of it: (the sprouts) were distributed to each unit. In the fourth year [+ 1314 to + 1315], because the distribution of mulberry trees to the units did not work well enough, the people were ordered to grow (mulberries) one each (of their own) fields."

All the mulberry tree planting activities that were executed in the various dynasties resulted in intensive silkworm breeding and, finally, in silk as a product to pay taxes in kind. The standard Sui tax, for example, consisted of three levies:

(a) the land tax at the rate of three bushels of grain per family per annum,
(b) twenty (earlier forty) feet (6 metres) of silk or linen cloth of a prescribed width plus three ounces (85 g) of silk floss or three pounds (1.4 kg) of hempen threads,
(c) labour service of twenty days per annum levied on all adult males.[0]

In early Thang times the *tsu-yung-thiao*[3], a direct system of taxation in grain, cloth and labour service was instituted."[1] During the Sung dynasty, apart from the *liang-shui* tax system, peasants were subject to the *tsu-shui*,* a sort of rent-tax collected in kind: the seven cereals *(tsa-tzu*[5]*),* nine types of silk fabrics and bean-creeper cloth, and various other items. Silkworms were paid as one item in the category 'various taxes' *(tsa-pien chihfu*[6]*).*[e] Apart from all these, the state had revenues from commercial taxes and monopolies.[1] From Pheng Ta-Ya, author of the *Hei Ta Shih Liieh* (Summary of Records on the Tatars) of + 1237 we are informed that in the years + 1232 to + 1233 in the area of north China, already conquered by the Mongols

village peasants (pay) 100 *Hang* [3.730 g] of silk per person (per annum).[8]

and

as for the Chinese population in the cities, with the exception of artisans, regardless of whether they are men or women, they (pay) an annual tax of twenty-five *Hang* [932-5 g] of silk per adult, and fifty *Hang* of silk per ox and sheep[h]

In + 1236 fundamental household categories were established; in addition there was the 'great majority' *(ta-shu-mu*[7]*),* subordinate directly to the emperor, and

[a] Schurmann (1), p. 55.
[6] *Yuan Shih* ch. 93, p. 2357; Schurmann (1), p. 55.
[c] Wright (9), pp. 94-5. [d] Wechsler (1), pp. 176-7.
[e] *Sung Shih,* ch. 174, pp. 4202-3; Lewin (1), pp. 136-7.
' Gernet (5), pp. 323-4. [g] *Hei Ta Shih Liieh, tshe* 31, p. 11.
» *Ibid.*

[1] 社 [2] 桑苗 [3] 租庸調 [4] 租稅 [5] 雜子
[6] 雜變之賦 [7] 大數目

the 'five household silk households' *(wu-hu-ssu-hu[l])*, who had to pay taxes to the Mongolian nobles.[a] Again, payment in silk comprising silk yarn, waste silk and coloured cloth of silk, can be considered the rule.

Later, in + 1260/1261, a decree fixed new quotas for the collection of silk, silver and land taxes; the extremely complicated system of household categories mainly concerned the household taxes *(kho-chhai[2])*,[b] the *ssu-liao[3]* (literally, silk material), and the *pao-yin**, originally a tax paid in silver.

That silk, either as a raw material or as a fabric, played a crucial role in the financial system of the Chinese economy may not only be deduced from the existence of the term 'mulberry land' and the tax-in-kind regulations, but. also from the figures about the amount of silk paid to the government as income tax in one year. Whether the enormous quotas given in various sources were always fulfilled is debatable, but the figures clearly indicate the economic dimensions and potency of China as a whole, based on the household tax registers from various periods.

We have only to cast a glance at the figures referring to woven silk fabrics of many different weaves during the Northern Sung period, to get an impression of the state of affairs in the + 1 ith century. In the *Sung Hui Tao Kao* (Draft of Documents Pertaining to Matters of State in the Sung Dynasty) the silk recorded amounts to many million rolls.[0] For the year + 1077 alone they numbered 2,670,000,[4] while in + 1074 the regions of Chekiang and south Kiangsu contributed 980,000 rolls.[6]

From the Mongol period we find that the amount of silk fibres (not including silk textiles) paid as household tax to the government amount to:[f]

Reign period Chung-thung 4th year (+ 1263)
712,171 *chin (c.* 425 tons);
Reign period Chih-yiian 2nd year (+ 1265)
986,912 *chin (c.* 589 tons);
Reign period Chih-yiian 3rd year (+ 1266)
1,053,226 *chin (c.* 628 tons);
Reign period Chih-yiian 4th year (+ 1267)
1,096,489 *chin* (c. 654 tons);
Reign period Thien-li ist year (+ 1328)
1,098,843 *chin (c.* 655 tons).

The figures which cover tax payments only and do not include the silk produced for private needs and the flourishing commercial silk market, which in Sung times was then regarded as one possibility of making money very fast (or going broke),

[a] **Schurmann (i), p. 73, n. 8.**
[b] ***Tüan Tien Chang,* 25, p. la; *Titan Shih,* ch. 93, p. 2361 ; Schurmann (1), p. 93, pp. 103-4.**
[0] *Sung Hui Tao Kao, (shih-huo),* ch. 64; Chang Chia-Chü *(2),* **pp.** 20-1.
[" **Gernet (5), p. 324.**
[e] Chang Chia-Chü (2), p. 21.
[' ***Tüan Shih,* ch. 93, p. 2363; Li Chien-Nung (5), p. 47.**

[1] 五戶絲戶 [2] 科差 [3] 絲料 [4] 包銀

lead to the conclusion that millions of people participated at least in the sericultural season from spring to late summer, and earned a substantial part of their means of living from producing silk.

(1) MULBERRY TREES

There exist in China many varieties of mulberry.[3] They all belong to the *Moraceae* family, falling broadly into the three following groups:

1. *Pai-sang*[1] *{Moms alba* Linn.);
2. *Ching-sang*[2] *{Monis bombycis* Koidz.).
   Both these types are commonly called 'wild mulberry'*yeh-sang*[3b] (Fig. 177). The *ching-sang* is not only native to China but also to Korea and Japan; it is mentioned as early as in the *Chhi Min Tao Shu* (The Important Arts of the People's Welfare) of the +6th century."
3. *Lu-sang* {Mortis alba* var. *multicaulis),* commonly called 'domestic mulberry' *chia-sang*[s d] which is in fact mostly a grafted variety where the large leaves of the *lu-sang* are combined with the strong trunk and root of the *ching-sang.*^ This gives a low shrubby tree having large dark, unlobed leaves with blunt teeth along the edges.' In the *Chhi Min Tao Shu,* the *lu-sang* is called *ske-sang*[6] or *ti-sang*[7], a piece of information which we find confirmed in the *Nung Cheng Chhiian Shuß* In the 19th century another name for *lu-sang* was *ku-sang*[8], because this variety of mulberry had spread from the Hu-chou area in northern Chekiang into the whole of the Kiangnan region.[11] The practice of grafting *lu-sang* on to a *ching-sang* stock began to be widely followed from the Yuan period onwards.[1]

Evidence of the mulberry pictographs on Shang oracle-bones has already been given,[J] but Satö Taketoshi[k] believes that *sang* was mostly used as a verb with the meaning 'to gather mulberry leaves'. However, quite apart from philological interpretations, there are textual sources which indicate that 'mulberry grove', *sang-lin*[9], was a common place-name, presumably derived from the presence of mulberry trees. So we read in the *Lü Skih Chhun Chhiu* (Master Lii's Spring and Autumn Annals) written in — 239 that in the reign of the first Shang ruler Chheng Thang[10] a drought destroyed the harvest for five years. In consequence, Chheng

[a] Silbermann (1), vol. 1, pp. 168-72; Chiang Yu-Lung (/), pp. 425-31; Chang Khai (5); Chou Khuang-Ming *[3).* For the sub-sections 'Mulberry Trees' and 'Silkworms' we could refer to a manuscript by the late Ohta Eizô, Kyoto, which is preserved in the files of The Needham Research Institute, Cambridge.

» *SILK,* p. 46.
a *SILK,* p. 46.
' Li Hui-Lin (16), p. 37.
[h] *SILK,* pp. 46, 51.
I See above, ch. (/), (2), (ii).
c *Chhi Min Tao Shu,* ch. 5, p. ib.
« Li (1), p. 1 a.
* *Chhi Min Tao Shu,* ch. 5, p. ib; *NCCS,* ch. 32.
' Amano *(13),* p. 382.
[k] Satö (/), vol. 1, p. 56.

[1] 白桑 [2] 荊桑 [3] 野桑 [4] 魯桑 [5] 家桑
[6] 虵桑 [7] 地桑 [8] 湖桑 [9] 桑林 [10] 成湯

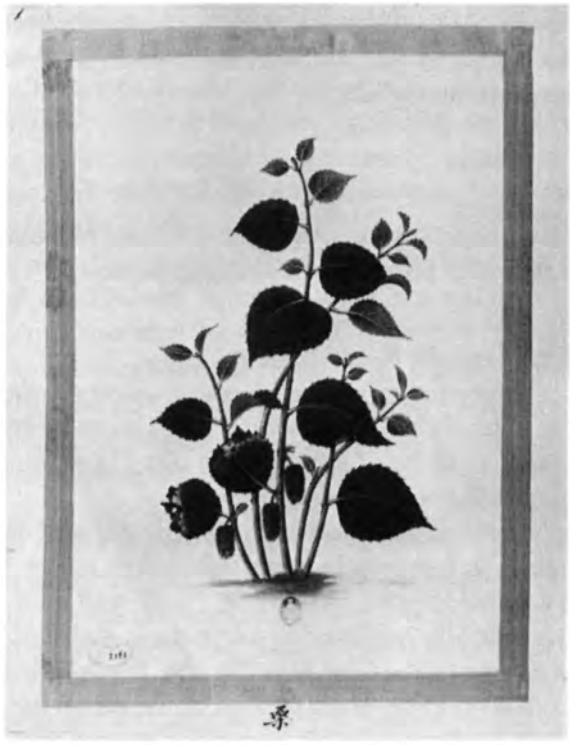


Fig. 177. Wild mulberry (*yeh-sang*), 19th century. Arbres et plantes, 19th century, Bibliothèque Nationale, Paris (Oe 86, pl. 6).

Thang went personally to pray in the 'mulberry grove' *sang-lin.*[a] Again, I Yin[1], who assisted Chheng Thang and became famous as his minister, is said to have been discovered as a baby in a *khung-sang*[2], a hollow cavity inside a partially rotted mulberry tree.[b] The trunk of an old mulberry tree would certainly be large enough to contain a cavity of a size to hold a baby, though the legend of I Yin is one of those connected with flood control. At the time of the great inundation, the water reached the level of the high plateau, but when it was later drawn off, ground suitable for the mulberry appeared; mulberry was grown and sericulture began.[0]

In *Mo Tzu* we read of the mulberry groves of Sung.[d] During the Warring States period Sung was ruled by a scion of the Shang, and the worship at the mulberry grove shrine may thus date back to Chheng Thang. In any case, worship in shrines situated in mulberry groves may have derived from the numinous awe felt towards the silence and seclusion of the large trees forming groves in the mountainous wilds of China. Indeed, some of the trees must have grown to huge sizes not easily yielding to the axe. The existence of such examples may be supported

[8] *Lii Shih Chhun Chhiu* , ch. 9, p. 3b.
[c] *Shang Shu Cheng I,* ch. 6, p. 147.
* *Ibid.,* ch. 14, p. 3ab.
* *Mo Tzu, {Ming kuei hsia*[3]*),* ch. 8, p. 142.

[1] 伊尹 [2] 空桑 [3] 明鬼下

by the well-known legend of the great tree *fu-sang*[ia] situated in the middle of either the Green Sea 'Sea of Jade' *(pi-hai*[2]*)* or the Eastern Sea *(tung-hai*[1]*),* which had two trunks, and roots supporting each other. Such ancient giant mulberry trees had an appearance similar to the Great Mulberry on Sado Island in the Japan Sea—a National Natural Monument—which consists of four trunks measuring 5.2 m in circumference at the base, with a height of about 9 m and their branches spreading some 18 m.

From the *Shih Ching* (Book of Odes) and other Chou sources we may deduce that the cultivation of mulberry trees was widely practised by farmers.[1]* The cultivation was executed either on a comparatively large scale in plantations or in the holdings of small farmers.

In the *Shih Ching* we read:[0]

> ... he measured mountains and hills by their shadow;
> he descended and inspected the mulberry grounds...

and we may add that he inspected the condition of the mulberry plantations

> .. .when it cleared during the night,
> early he yoked his carriage,
> he halted in the mulberry fields...[d]

to set the peasants to work. These lines definitely suggest a connection with sericulture. The tasks performed consisted of various activities, the *Shu Ching* (Book of Documents) speaking of Yen-chou[4] (in Shantung) mentions that the mulberry grounds were stocked with silkworms.[e] Furthermore we are informed:[1]

> ... in the silkworm month we branch the mulberry trees;
> we take those axes and hatchets, and lop the
> far-reaching and high-rising ones;
> luxuriant are those small mulberry trees
> *(nii-sang*[5]*)*[e]...

We learn:[h]

> Inside the ten acres, the pickers of mulberry leaves are moving leisurely...

Gathering mulberry leaves appears to have been the job of girls:[1]

> ... in the days of spring there is warmth,
> there is the singing oriole;
> the girls take their beautiful baskets,
> they go along those small paths;
> they seek the soft mulberry (leaves)...

» *Shan Hat Ching, (hai wai tung ching*[6]*),* ch. 9, p. 2b; *CWTTT,* 12119 (57).
" Amano *(4),* pp. 142-4. ° Karlgren (14), p. 33, no. 50. d *Ibid.*
[e] See Karlgren (12), p. 14; Medhurst (1), p. 91. 1 Karlgren (14), p. 98, no. 154.
[8] Also called »[7]; obviously not a mulberry tree, see Chiang Vu-Lung (/), pp. 426-7.
» Karlgren (14), p. 71, no. in. 1 *Ibid.,* p. 97, no. 154.

[1] 扶桑 [2] 碧海 [3] 東海 [4] 兗州 [5] 女桑
[6] 海外東經 [7] 桋

and they gathered the leaves

In that ground by the side of the Fen...[a]

which means along the Fen[1] River in the southern part of Shansi.

In *Meng Tzu* we read:[b]

Let mulberry trees be planted about the homesteads with their five *mou*...

But quite apart from the economic benefit of mulberry trees to the farmers, mulberry grounds obviously served as ideal places for lovers to meet.

.. .she gave me a time (to meet her) in the mulberry grounds.. .[c]

Another time the girl warns her lover

. .. do not leap over my wall,
do not break our planted mulberry trees...[d]

In a region like north China with heavy late frosts, the young leaves to nourish the spring silkworms would not have time to appear if, as in Japan, the tree was kept cut back to the root-stock. Yet it is unlikely that the Chinese in Chou times had yet reached the stage of deliberately shaping the mulberry trees as was certainly done from + 13th century onwards; with small trees they simply pulled down the branches and stripped off the leaves, while with tall ones the branches would be lopped with axes and the leaves removed that way. Texts and pictorial evidence confirm this assumption.

For the 23rd year of Hsi-kung[2] (— 637) the *Tso Chuan* (Master Tso's Tradition) relates a story in which a mulberry tree plays a crucial role.[e] Chung-Erh,[3] Prince of Chin, had taken refuge in Chhi,* then although Duke Ffuan[5] had married him to a noble lady, he tried to escape from the region after the duke had died. When Chung-Erh was plotting his escape under a mulberry tree, a silkworm servant-girl in the tree overheard the conversation and informed Lady Chiang. Lady Chiang, the wife of Chung-Erh, killed her. She feared that the girl would talk. That the girl could sit in the tree tells us that the mulberry tree was a fully-grown one of the type still to be found in modern Shantung.

Certain rules for the cultivation of mulberry trees are propounded in the *Li Chi* (Record of Rites) :[f]

In the last month of spring, orders were given to foresters throughout the country not to allow the cutting down of mulberry trees and silkworm oaks.. .the trays and baskets with the stands (for the worms and cocoons) were got ready.

[a] ***Ibid.*, p. 69, no. 108.**
[b] **Legge (3), ch. 111=4.**
[0] Karlgren (14), p. 31, no. 48; on girls picking mulberry leaves, see Tsou Ching-Heng *(6),* pp. 1-8.
* ***Ibid.*, p. 51,** no. 76.
[e] **Yang Pai-Hsün** (/), vol. **1,** p. 406. [f] *Li Chi Cheng I,* in *SSCCS,* ch. 15, p. 1363.

[1] 汾 [2] 僖公 [3] 重耳 [4] 齊 [5] 桓

The poem 'Plucking mulberry leaves' *(tshai sang*[1]*)* by Hsiao Kang[2] (+503 to +55[1])) [w]ho reigned as second emperor of the Liang Dynasty (+502 to +557), also attests to the assumption that the mulberry trees were not cut down, but that the girls tried to reach the branches or had to climb them:[a]

> .. .Toward evening, afraid that the silkworm will be hungry,
> she hastens to pluck the spring mulberry leaves.
> Chatting the while with companion mulberry girls,
> how surprising that the spring day is so short!
> The branches are lofty and she cannot pull them down;
> the leaves are very fine and the basket's hard to fill. . .

A change in the technique of picking mulberry leaves may have occurred in the first half of the + ist millennium. The *Chhi Min Tao Shu,* written between +533 and +544 informs us:[b]

> When gathering mulberry leaves in the spring use long ladders or tall platforms [Figs. 178, 179], several men to each tree. The twigs and branches which have been bent (in plucking the leaves) should be returned to their original position, and the leaves should all be removed as carefully as possible.... When gathering leaves in the autumn, exercise restraint. Defective twigs and branches should be lopped off and thrown away...

Gathering mulberry leaves, most probably from the large grown *Monis bombycis,* is depicted on a number of bronze vessels of the Warring States period, on stone reliefs from Han times and on mural paintings from Wei-Chin tombs (+220 to +317). Nunome has already discussed eight examples of mulberry pictures on bronzes, all worked in inlay on the bronze surface of the vessels.° Five of these eight examples show very large mulberry trees; three appear to be relatively small. Though various types of mulberry trees are depicted, there is insufficient evidence for us to identify definitely the types of tree.

Representative examples are the bronze *hu*[3], now in the Palace Museum, Peking* and a similar vessel of the early Warring States period (—5th century) found in tomb no. 10 at Pai-hua-than[4] Middle School in Chheng-tu, Szechwan province (Figs. 180, 181).[e] On the necks of both slender but large mulberry trees with pointed leaves are shown. Women have climbed into the trees, while there are other figures beneath. A basket for leaves *lung*[s] (Fig. 182) in the shape of the

[a] Mamey (1), p. 13.
[6] *Chhi Min Too Shu,* ch. 5, p. 2b.
[0] Nunome (/), fig. 15-1; Nunome (5), p. 301; Hayashi (j), fig. 3.
[a] A profound study on the *hu* has been made by Eleanor von Erdberg Consten (1). Also pictured in vol. 4, pt. 1, p. 144, fig. 300; Nunome (/), fig. 15-1: 1; the illustration is reproduced in colour in Yonezawa Yoshiho (/), vol. 8, p. 40, fig. 23.
« Anon. *{616),* pi. 2; Nunome (/), fig. 15—1: 4. In a private letter dated 1 May 1984, Nunome Junrö has pointed out that the sex distinction is noticeable. The male is generally of larger build and has two or three types of top-knot or headgear, whereas the female is generally of small build, with the hair hanging down the back and tied with a ribbon. See also Thung En-Cheng (/), pi. 15; p. 4, fig. 3.

[1] 採桑 [2] 蕭綱 [3] 壺 [4] 百花潭 [5] 籠



Fig. 178.



Fig. 179.

Fig. 178. Platform for gathering mulberry leaves (*sang-chi*), +1313. *NS* (+1530 ed.), ch. 23, pp. 1ab.
Fig. 179. Ladder for gathering mulberry leaves (*sang-thi*), +1313. *NS* (+1530 ed.), ch. 23, pp. 2ab.

character *thien*[1] is shown hanging from a branch on the right-hand side. One young girl has picked up a basket to carry away and is handing a 'mulberry hook' *(sang-kou*[2], Fig. 182), a stick with one end curved back, to another girl opposite her. Among the girls stands a matron, raising her two arms to heaven. It is a scene of hard but pleasant work, bathed in the spring atmosphere. From the representation it appears obvious that the use of ladders or stands was not yet common. This *hu* probably was not produced in Szechwan but imported from a technically more advanced area, because similar inlaid bronze examples have been discovered in other regions.

A tile excavated from a Han tomb at Chheng-tu[a] (Fig. 183) illustrating a mulberry plantation *{sang-yuan*[3]*)* was manufactured in Szechwan, as may be deduced from the composition of the material. The gate and the guardian on the relief indicate that the plantation was situated in a fenced or walled compound, similar to that on a tomb tile from Wei-Chin times (Fig. 185).

[a] Liu Chih-Yiian (/), pi. 1:2; Anon. *(742),* p. io, fig. 4,

[1] 田 [2] 桑鉤 [3] 桑園

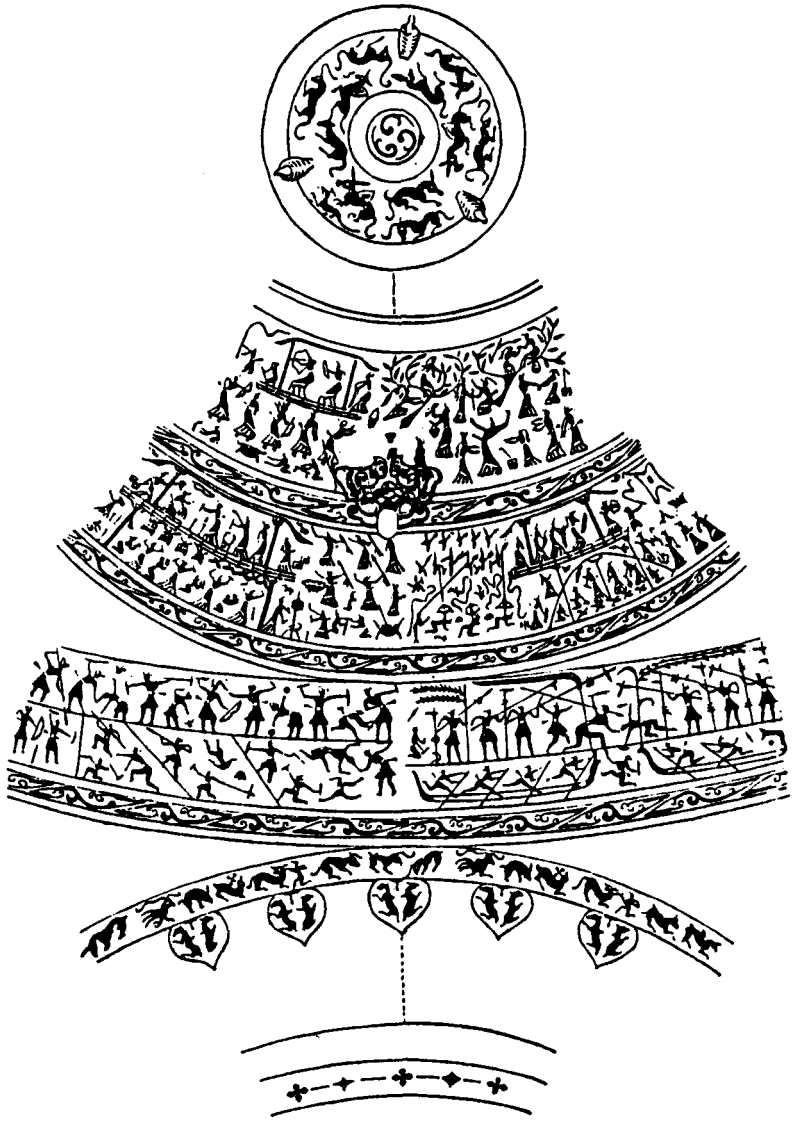


Fig. 180. Gathering mulberry leaves, —5th century. Bronze *hu* of the Warring States period, excavated in Chheng-tu, Anon. (*616*), pl. 2.

Another illustration of a mulberry tree—which we will not reproduce here because of its poor quality—can be found on the rear side of the Wu-liang-tzhu[1] shrine from Chia-hsiang in Shantung province. In it we can see a badly preserved representation of the story of Chhiu Hu[2] of Lu[3] and his wife.[a] The names of the *dramatis personae* are engraved on the stone. The story is given in the *Lieh Nu*

" Nagahiro Toshio (/), p. 68; on the Wu-liang-tzhu see also Croissant (i), p. 144, n. 171 (Lu Chhiu Hu).

[1] 武梁祠 [2] 秋胡 [3] 魯



Fig. 181. Gathering mulberry leaves (detail). Nunome (*1*), fig. 15–1: 4.

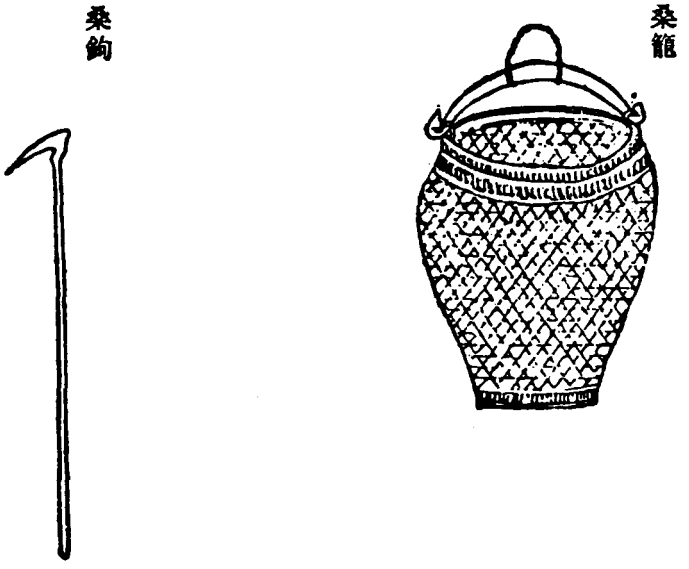


Fig. 182. Mulberry hook (*sang-kou*) and mulberry basket (*sang-lung*), +1313. Wang Yü-Hu (*2*), pp. 397, 398.

Chuan (Biographies of Celebrated Women).[a] Five days after his marriage, Chhiu Hu went to take up an official post in Chhen[1], and only returned five years later. The scene shows him stopping to banter with a woman gathering mulberries by the roadside. The woman is actually his wife, and the object in her hand appears

[a] O'Hara (1), pp. 141–3.

[1] 陳



Fig. 183. Mulberry plantation (*sang-yüan*), Han dynasty. Relief on a brick from a tomb in Chheng-tu, Szechwan province, Liu Chih-Yüan (*1*), pl. I: 2; the rubbing is reproduced from Nunome (*1*) fig. 17–1 top.

to be a mulberry knife *(sang-tao*[1]*)* for cutting the mulberry leaves. The strangely-shaped object on the right-hand side must be a mulberry tree.

In mural paintings on tomb tiles, illustrating the life of the local people at Chia-yu-kuan[2] in Kansu province, and dating from the Wei-Chin period, there are several pictures of mulberry leaves being gathered *{tshai sang*[3]*).**[1] One of these (Fig. 184)—in the north wall of the front chamber on the east side—shows a woman holding a round basket in one hand and a stick-shaped object, a mulberry hook, in the other. The mulberry tree depicted divides above the roots into several trunks. The tree is drawn as if it were at some distance, and so appears to be actually a large one. Another tile (Fig. 185)—in the south wall of the front chamber on the west side—shows the guarding of mulberry trees in a walled compound which can be entered through a door. The guardian stands outside the entrance. A similar scene is pictured in Fig. 183.

On all the early and later illustrations (Fig. 186) mulberry baskets are shown although the mulberry net *(sang-wang*[4]*)* may have been known and used as well (Fig. 187). The illustration in the *Nung Shu* depicts three sturdy mulberry trees, two of them already harvested. One man is gathering the leaves in a net spread on the ground, another is carrying a net on his back. The net could be drawn together by a rope in a similar fashion to a fishing net.

To increase the production of leaves, mulberry trees were grafted and also had to be pruned so that they would not grow taller than four to six feet,[b] which

[a] Anon. *(6ig),* p. 38, figs. 13, 14; Anon. *{512),* figs. 46, 58; Nunome (/), fig. 15-3B; Fontein, Wu Tung (1), figs. 67, 68. t> Li (1), pp. 13-15.

[1] 桑刀 [2] 嘉峪關 [3] 采桑 [4] 桑網



Fig. 184. Gathering mulberry leaves (*tshai sang*), +3rd century. Anon. (*512*), fig. 46.



Fig. 185. Mulberry plantation (*sang-yüan*), +3rd century. Fontain & Wu Tung (1), fig. 68.



Fig. 186. Gathering mulberry leaves; hanging scroll by Shen Shih-Keng 沈士鯁 (active *c.* +1620 to +1645), dated +1642. Chang Ying-Hsüeh (*1*), pl. 13.



Fig. 187. Mulberry net (*sang-wang*), +1313. *NS* (+1530 ed.), ch. 23, pp. 5ab.

immensely facilitated their proper care,[a] and made it possible to gather the leaves without a ladder. As is pointed out in Chhing manuals* on the cultivation of mulberry trees, local variations were common.[0]

In her valuable study on the yields of mulberry leaves in Kiangnan, Lillian M. Li arrived at the conclusion that the yield of mulberry trees was highly variable, depending on a wide variety of factors such as the age and height of the trees, the density of planting, and the number of crops picked per year, and consequently difficult to measure with any accuracy.[d] ' In short, in mulberry growing as in other areas of traditional Chinese agriculture, intensive cultivation, dependent on the patience and hard work of the peasant, brought optimal results.'[6]

An optimal result reported from Chia-hsing[1] (+ 16th to 19th centuries), could be achieved when trees were planted in a scattered fashion—one hundred trees

* Li (1), p. 15; Anon. *(740),* pp. 73-4; Yüeh Ssu-Ping *(1),* p. 20.
" *HTS,* pp. 13-14; *KTSSCP,* pp. 4b-7b; *TSCMCS,* p. 8; *TSTL,* pp. 7b-8a.
[c] *TSS,* pp. 2a~3b; Chhen Heng-Li, Wang Ta-Tshan (/), p. 251 ; *TSCMCS,* pp. ga-ioa.
[a] Li (1), p. 15; table 1 on p. 16. [e] *Ibid.,* p. 18.

[1] 嘉興

per *mou,* which would yield 2,000-3,000 catties of leaves per *mou* per year.[a] The enclosed method of planting mulberries only produced between 800-2,000 catties of leaves per *mou* per year in + 17th century Chia-hsing, depending on the quality of land.[b] It should be noted that these results were outstanding. Even nowadays the average yields are much below the late Ming standards.[0]

(2) SILKWORMS

A discussion on silkworms has really to start with the most detailed passage in ancient literature dealing with the silkworm, *tshan*[1]. It is a riddle by Hsiin Tzu, a philosopher of the — 3rd century,[d] which shows great insight into the relationship between man and silkworm:[e]

There is a certain thing; its body is naked but has the power to transform itself many times, like a god. Its merit can clothe and ornament everything under heaven, to the ten thousandth generation. Through this rites and music are completed and the noble and base are distinguished. Nourishing the aged and bringing up the young—if you do this, they will live. Its name is not beautiful, being a close neighbour to tyranny.* When its merit is established, its body is destroyed; when its work is completed its house is overthrown; its elders are thrown out and its posterity is taken. This is that from which men profit and which birds hate. I am stupid and do not know what it is, and so I ask the oracle Wu Thai.

There follows the oracle's answer: Is not this the thing with the soft, tender body and the horse's head? Is not this the thing that changes many times and yet does not attain old age? The thing that is wise in youth (and able to feed itself) but stupid in age (and unable to defend itself)? The thing that has father and mother, but no male and female? It dies in winter and plays (changes) in summer; it eats the mulberry and spits out silk; it creates first disturbances and then order; it burgeons in summer but dislikes heat; it rejoices in damp weather but dislikes rain. Its mother is called chrysalis *(yung*[2]*),* its father is called moth (0[3]). It lies down to sleep three times and rises three times and then its great work is achieved. This is the way of the silkworm *(tshan).*

The history of the domesticated silkworm *Bombyx mort* L. in Europe and sericulture in general there, has attracted not only scholars from various fields but also merchants and silkworm breeders. In the context of this study it is not possible even to list the works published in + 18th and 19th century Europe; there are too many.[g] For reasons of clarity and straightforwardness we have therefore concentrated on a few works, only consulting the most fundamental and recent European

[a] *HTS* p. 20; Chhen Heng-Li *(1),* pp. 38-9.
[b] Chhen Heng-Li (2), pp. 36-7. [c] Li (1), p. 17.
[d] Dubs (7); Forke (13), pp. 216-22.
[e] As far as we know a translation of the riddle has not been published; *Hsiin Tzu,* ch. 18, fu 26, pp. 316-17; see also Tsou Ching-Heng (5), pp. 1-8.
[f] The character for a silkworm and a character, meaning tyranny, cruelty, are homophones.
[g] Bibliographies (including patents registered in Europe) are contained in Silbermann (1), vol. 1, pp. 150-61, 274-8, 339-4°. 507-I3-

[1] 蠶 [2] 蛹 [3] 蛾

and East Asian studies and sources on the subject.[8.] However, before investigating Chinese sources so as to find out about the various silkworms reared and used in China, it is desirable to outline the typical life-cycle, morphology and characteristics of the domesticated silkworm in both China and Europe.

The *Bombyx moriL. (sericaria)* belongs to the family *Bombycidae (tshan-o-kho[l])* in the order of the *Lepidoptera (lin-chhih-lei[1]) nocturno.* The morphological development comprises several stages : egg *(luan[3])*—caterpillar *(tshan*)*—chrysalis *(yung[5])*—moth (o[6]). The caterpillar spins the silk so as to make up the cocoon *(chien[7])* before its metamorphosis into a chrysalis inside the cocoon. The eggs of the monovoltine types producing only one generation a year are kept in winter inside folded paper at temperatures of some 4-5 °C, before they are hatched out in spring. 'The hatching of the silkworm eggs varies with the temperature of the different provinces. When the leaves of the mulberries have attained the size of a copper coin it is the time for worms to emerge from the eggs.'[b] About ten days previously, the papers containing the originally pale-yellow eggs, called graine, each measuring 1 mm in diameter, are rolled up and wrapped round with paper and cotton. The rolls are stored in a warm place. After six or seven days the eggs have changed to a green colour, and the worms are about to emerge. The black and hairy worms are called *i*[s], ants, because they resemble ants in appearance, and measure 2-3 mm in length. The worms are now moved from the paper to a bamboo basket and spaced with a fine feather or brush so that they do not lie together too closely. These ' newly hatched ' one- or two-day old silkworms are called *miao*[9]. As a rule it takes 30 to 35 days before the caterpillars attain a length of about 9 cm, and their colour varies from an ashy-grey or cream-colour to a yellowish-white. The larva is hairless and slender, and grows rapidly (Table 5), undergoing several moultings or so-called 'sleeps' *(mien)*[10]. The silkworms raised in south China and the ones in Europe have four periods of moulting—the 4th, 12th, 19th and 27th days after emerging from the egg, but the northern silkworm generally casts its skin three times. The caterpillars have to be disturbed very often not only because they grow so fast but also for hygienic reasons. When they have finished moulting and are mature for making up their cocoons—which normally happens around 33 days after emerging from the egg—they are placed on so-called silkworm hills, con-

[a] The books and articles listed below deal with silkworms and silkworm breeding; the list is far from complete—many more titles are quoted on the pages below—but may be regarded as a guide for further reading: *NSCT,* ch. 4, pp. ia-i3b; *JVS (+* 1530), ch. 6, pp. ia~5a; ch. 22, pp. 3ia~32a; *NCCS,* chs. 31, 32; *TKKW,* ch. *shang,* pp. 24.b-2o.b; *KCT,* reproduced in Franke (11), poems, pp. 127-34 [an(^] plates; similar illustrations can be found in various works, see Kuhn (2), pp. 346-7; *SSTK,* ch. 72, 73; *HTS,* pp. 73-4; *KTSSCP,* ch. 2, pp. 3b-6a; *TSCMCS,* pp. iga-22b; *TSTL,* pp. nb-i3b; Anon. *{753),* pp. 2576-8; Chiang Yu-Lung (/), pp. 431-5; Amano *(4),* pp. 139-54; Nunome *(1),* pp. 164-211; Chou Khuang-Ming *(4,5);* Chang Khai *(4);* Chiang Yu-Lung *(2);* Reichenbach (1); Julien (12); *SILK,* pp. 49-56; Silbermann (1), pp. 163-277; Wagner (1), pp. 425-39; *EB,* vol. 25, pp. 96-103; *GTL,* vol. 1, pp. 187-8, vol. 2, pp. 356, 365-6; Bock (1), vol. 6: 1: Die Seidenspinner, pp. 1-10; Pigorini (1), pp. 146-86; Sun (1), pp. 38-42; Li (1), pp. 18-24.

" *SILK,* p. 50.

[1] 蠶蛾科 [2] 鱗翅類 [3] 卵 [4] 蠶 [5] 蛹
[6] 蛾 [7] 繭 [8] 蟻 [9] 蚒 [10] 眠

Table 5. *The Growth of Silkworms*
Source: Henri Silbermann (1), p. 178.

	Length (mm)	Weight (g)	Quantity of leaves consumed (g)
After emerging from the egg	3	0.00045	
End of the ist sleep	8	0.00675	0.104
End of the 2nd sleep	18	0.04230	0.312
End of the 3rd sleep	28	0.18000	1.036
End of the 4th sleep	45	0.73260	3.110
Mature for spinning	87	4.00000	18.720

structed from bundles of straw. Each bundle holds 60 to 70 larvae. It takes about four days before the cocoon is finished (Fig. 188; Fig. 189).

The body of the caterpillar consists of a hard head *{caput),* three thoracic segments and the eleven abdominal segments, the eighth with a dorsal horn. To produce the silk filaments, the caterpillar has silk-glands which consist of two long sacs running along the sides of the body (Fig. 190; Fig. 191). The spinneret or seripositor opens on the under lip of the larva. To make the cocoon, the larva ejects a continuous brin from both glands simultaneously by moving its head round in a figure-eight regularly for two to four days. The natural filament consists of two brins—fibroin of white, semi-transparent protein with a jade-like lustre—which appear to the eye as a single thread; it is covered by sericin (silk-gum). Only after degumming—boiling the silk in a mildly alkaline solution—can the individual brin filaments separate.

When rearing silkworms, those cocoons which are hard, clean and white are selected for breeding. Only a relatively small number of moths, sufficient to secure the production of eggs for the new generation, are allowed to break through the cocoons (Fig. 192). The moths are allowed to mate; this takes between 8 and 10 hours, after which the male moths are removed. The females lay their eggs on thick paper, and, when they have finished, they will live without eating for five days; they then die. The paper with the eggs is folded, tied together and hung up. Various actions are taken to preserve the eggs until the third month of the following year, when the cycle starts again. Apart from the caterpillars selected for breeding, all the other chrysalises inside the cocoons are killed to obtain the unbroken and undamaged silk filaments fit for reeling.

Among silk producing insects, there are some that lay eggs several times in one year. This quality is called voltinism *(hua-hsing*[1]*).* In Europe the commonly reared

[1] 化性

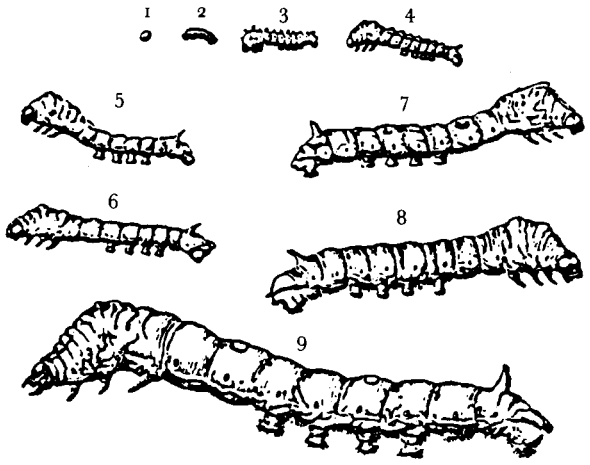


Fig. 188. Development of the silkworm. 1. Egg; 2, after emerging from the egg; 3, first moulting; 4, second moulting; 5, before the third moulting; 6, after the third moulting; 7, before the fourth moulting; 8, after the fourth moulting; 9, mature for spinning the cocoon. Silbermann (1), p. 178, fig. 40–8.

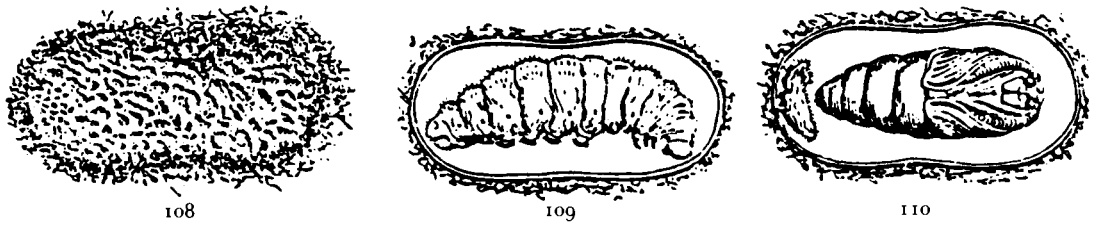


Fig. 189. Cocoon of *Bombyx mori*. 108, cocoon of *Bombyx mori*. 109, longitudinal section through the cocoon after the cocoon had been spun by the caterpillar. 110, longitudinal section through the cocoon after pupation. Silbermann (1), p. 207, figs. 108–110.



Fig. 190. Longitudinal section through silkworm. 1, bloodvessel; 2, intestinal gland; 3, silk-gland. Silbermann (1), p. 183, fig. 53.

silkworms produce as a rule only one generation during the year; they are monovoltine *(i-hua[1])*. In subtropical and tropical climates where mulberry leaves are available all the year round, bivoltine *(erh-hua[2])* or polyvoltine *(to-kua[3])* silkworms producing two or more generations in one year are usual. There it takes only ten days until the caterpillars emerge from their eggs.

In central China two generations, spring and autumn silkworms were raised.

[1] 一化 [2] 二化 [3] 多化

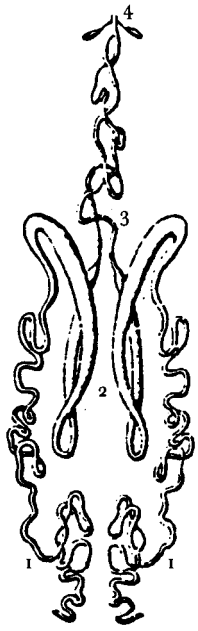


Fig. 191. Silk-gland of the *Bombyx mori*. 1, secreting part; 2, storage part; 3, excreting part; 4, Fillipis glands. Silbermann (1), p. 184, fig. 54.

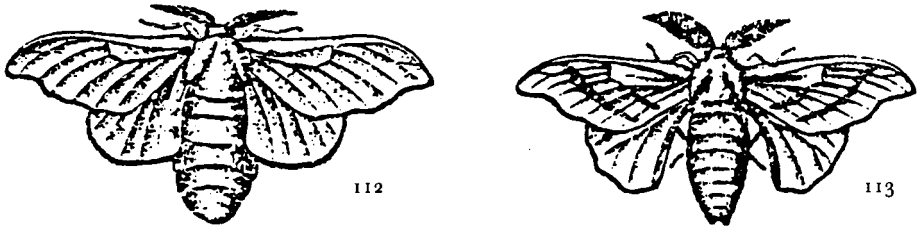


Fig. 192. *Bombyx mori*—moths. 112, female *Bombyx mori*; 113, male *Bombyx mori*. Silbermann (1), p. 208, figs. 112, 113.

The spring crop moulted four times *(ssu-mien[1])*, the summer crop three times *(san-mien[2])*. The silk produced was white in colour and fine in texture." In south China, a 'tropical' variety of the silkworm could produce several generations each year; its silk was softer and shinier, but coarser than the central Chinese variety.[b]

The *Thien Kung Khai Wu* (The Exploitation of the Works of Nature) of + 1637 by Sung Ying-Hsing explains:[0]

[a] Li (1), p. 18; Anon. (608), p. 6.
[b] Li (1), p. 18; Howard and Buswell (1), p. 66; Lieu (1), p. xii.
[c] *TKKW*, ch. *shang*, p. 24b; translated by Sun (i), p. 37.

[1] 四眠 [2] 三眠

There are two varieties of silkworms, the early (monovoltine) and the late (bivoltine).[a] Each year the late variety hatches *[chhu'*) five or six days ahead of the early variety—those of Szechwan province are different. It also makes up the cocoon *(chieh chien*[2]*)* earlier than the other. In weight the cocoons of the late variety are lighter by one-third. When the early silkworms make up their cocoons, the late ones have already changed into moths, laid eggs and so are ready for a new crop (within the same season).—The chrysalis of the late silkworm is absolutely inedible.

This reliably describes silkworm breeding in late Ming times. Having now an idea of the situation in Ming and Chhing times, we should next ask, what silkworm breeding was like in earlier periods of Chinese history? What do we know about voltinism and which were the types of silkworms raised? To begin with we shall attempt to answer the question of voltinism and then turn to the 'history' of the various types of silkworms in China.

In the *Hsiin Tzu* of Chou times silkworms are described as '... lying down three times and rising three times.. . '.[b] So the silkworms described must have been three-sleep silkworms *(san-mien-tshan*[3]*).* In the *Huai Man Tzu* (The Book of (the Prince of) Huai-Nan) of about — 120 we find the statement :[c] ' Silkworms eat but do not drink and change on the twenty-second day.. .'. This can be substantiated. The *Chhi Min Too Shu* quotes the following passage from the *Chhun Chhiu Khao I Tu* (Apocryphal Treatise on the Spring and Autumn Annals) :[d]

Silkworms *are yang-ihings.* They greatly dislike water. For this reason, they eat but do not drink. *Tang* is manifested in the three months of spring. So the silkworms change three times and then are spent, dying on the seven. Three sevens are twenty-one days, so they spin their cocoons on the twenty-first day. One age for the silkworm is seven days and after passing through three ages they spin their cocoons.[e]

From the three changes (larva-pupa-moth) we may judge that they are three-sleep silkworms that made their cocoons in about three weeks. Moreover, the description indicates that it may have been a primitive type, forming spindle-shaped cocoons of poor quality silk, closely related to the original wild *hsiang,* kuwako*[5] or *Bombyx (Theophila) mandarina (yeh-tshan*[6]*).*

The *Teh Tshan Lu* (Record of Wild Silkworms), compiled by the scholar Wang Yuan-Yen, and given a preface in 1902, informs us that the term *sang-tshan*[1] refers to a wild silkworm. This creature lives on the leaves of the mulberry and its

[a] Explained by Chung Khuang-Yen (/), p. 59, n. 2: 'early' and 'late' are also explained by Sun (1), pp. 70—1, n. 2: 'The early and late varieties of silkworms refer to the annual...and polyvoltine...classes respectively. Although the first generation of the latter is hatched somewhat earlier than the annual variety, the last bit of work involved with it could be finished later than that of the one-crop worm, therefore it is here called the late variety.'

[b] See above, p. 301.

[c] *Huai Nan Tzu,* ch. 17, p. 7b; quoted in *NCCS,* ch. 31, p. 2a.

1 *CMTS,* ch. 5, pp. 4ab; quoted in *NCCS,* ch. 31, p. ib.

[e] Ishimori (/), p. 6; Amano (4), p. 157

[1] 出 [2] 結繭 [3] 三眠蠶 [4] 蠔 [5] クワコ
[6] 野蠶 [7] 桑蠶

colour resembles mulberry bark; its head is slightly uplifted, its length about 3 cm; the cocoon is dusky-white in colour, small and hard. The moth is ashen yellow with black markings, resembling the moth of the domesticated silkworm; it spins its cocoon in both spring and autumn. This silkworm he called *hsiang*[1]. Wang came from Hai-ning[2] in Chekiang, and had probably seen that primitive silkworms lived not only in the Yangtze valley region but also in Shantung, and tells us that among Shantung silkworms, apart from the well-known annual three-sleep domestic type, there was also a three-sleep one which was bivoltine.

That the Chinese reared a bivoltine species very early on may be seen from the *Chou Li* (Record of the Institutions of the Chou Dynasty) where we read:[a] 'He forbade the raising of a second crop of silkworms in a year.' A passage in *Huai Nan Tzu* rationalises the prohibition:[1]"

*Yiian-tshan** breed twice in one year. This is not without profit, but the reason that sage-kings prohibited it was that too much cutting of the mulberry leaves damaged the trees.

So the rearing of the large-bodied four-sleep silkworm *(ssu-mien-tshan*[4]*)* may have already been practised for centuries before its existence was stated by the trustworthy official and scholar Chia Ssu-Hsieh in his *Chhi Min Tao Shu.* We read:[0]

Nowadays there are the three-sleep one-change *(san-wo i-sheng*[5]*)* silkworms and the four-sleep two-change silkworms *(ssu-wo tsai-sheng*[b]*)...*

The four-sleep silkworm is mentioned in the *Tshan Shu* (Treatise on Sericulture) of about + 1090 by Chhin Kuan[d] and in the *Nung Shu* by Wang Chen. There we learn:[6]

In the north there are many three-sleep silkworms, but in the south they are all of the four-sleep variety.'

From the information available, we may conclude that the three-sleep silkworms—the white cocoon type—are a primitive variety, close in many respects to the original wild mulberry silkworm. A distinction between wild and domesticated forms is hard to make, but with the appearance of the four-sleep silkworm—the yellow cocoon variety—domestication can definitely be inferred.[8] If blessed with a warm climate, plenty of tender mulberry leaves and adequate care, the three-sleep silkworms would turn into four-sleep ones. So probably the varieties became

• Biot (1), vol. a, p. 190: the commentary explains *yuan''* as *tsai**.
t> *Huai Man Tzu*, ch. 20, p. 18b.
[c] *CMTS*, ch. 5, p. 6a.
a *TS*, p. I.
[e] JV5 (+ 1530), ch. 6, p. 4a.
' This information is confirmed in *Tshan Sang Shih Chi* (Reality of Sericulture), quoted in Amano *(4)*, P- 157-
[g] Ishimori Naoto *(1)*, p. 6; on the problem of colour, see below.

[1] 蠭 [2] 海寧 [3] 原蠶 [4] 四眠蠶 [5] 三臥一生
[6] 四臥再生 [7] 原 [8] 再

fixed. This means the attribute of three or four sleeps was not a fixed quantity but influenced by the breeding techniques and the treatment the silkworms received.[a]

A method of stimulating hatching, already mentioned in the *Li Chi* (Record of Rites) was to wash the silkworm eggs *(yii chung[1]).* Artificially induced breeding methods turning bivoltine silkworms into trivoltine by temperature stimulation was already known in Sung times (+ 420 to +479). Cheng Chi-Chih remarked in his *Tung-Chia-Chün Chi* (Records of Yung-chia Prefecture (in Chekiang Province)) :[b]

In Yung-chia there are eight types of silkworms *(pa pei tshan[2]) : yiian-chen[3]*—spins in the third month; *che-tshan** (oak spinner (perhaps *Antheria pernyi* or *Saturnia cynthia))*—spins at the beginning of the fourth month; *yiian-tshan**—spins at the beginning of the fourth month; *ai-chen[6]*—spins at the fifth month; *ai-tshan[7]*—spins at the end of the sixth month ; *han-chen[8]*—spins at the end of the seventh month ; *ssu-chhu-tsharfi*—spins at the beginning of the ninth month; *han-tshan[10]*—spins in the tenth month.

When the silkworms pupate twice in one year, the worms of the first crop are called *chen[11]*. People raise only a small number of these. *Ai-tshan[12]* are a variety *of yiian-tshan[13]*. The *yiian-chen* spin their cocoons early, in the third month. The moths emerge and lay their eggs ; seven or eight days later the eggs hatch and the new silkworms appear. (This time) many people raise them. These *are yiian-tshan.*

To produce *ai-tshan,* one takes the eggs of the *yiian-chen* and places them in a pitcher with a wide body and a narrow neck. Depending on the size of the pitcher, up to ten egg-cards can be inserted. The mouth of the pitcher is covered and it is placed in the cold water of a rocky spring. The cold delays hatching. In three times seven days [21 days] the eggs hatch and the larvae appear. Those who raise them call them *ai-chen* or *ai-tzu[1]**. They spin their cocoons, and the moths emerge and lay eggs. After seven days these eggs also hatch into silkworms. These are raised in large numbers and they are called *ai-tshan. ..*

The level of the water should be just the level of the eggs in the pitcher. If the water outside is too high, the eggs will die and not hatch. If the level of the water outside is lower than that of the eggs, the chill will be less and will not retard hatching; if hatching is not retarded, the eggs cannot be preserved for three times seven days [21 days] ; if they are not preserved for 21 days, then even though they hatch, they will not spin cocoons.

(The *ai-tshan)* make their cocoons, the moths appear and the eggs are laid, but these eggs do not hatch after seven days but hatch the following year. (The eggs) should be stored in the shade of trees or one may seal the mouth of the pitcher with mud...

From the same source we learn that oak-spinners and four-change silkworms were used; furthermore the *yiian-tshan* and *han-tshan* are defined as bivoltine silkworms.

[a] According to Ishimori Naoto *(1),* pp. 3-4, the wild silkworm was the original **form of the silkworm. The** chromosome count in the reproductive cells of the *kuwako* (wild silkworm) is 27, and **in the** *kaiko* (domesticated silkworm) it is 28. One set of chromosomes in the *kuwako* split, making 28, so the **domesticated** silkworm was developed from the wild form—this derives from the cytological research **of Kawaguchi** Eisaku[IS]; see also Amano *(4),* p. 140.

[b] *CMTS,* ch. 5, pp. 5ab; *NCCS,* ch. 31, pp. 8ab; *Thai-Phing Yii Lan,* ch. 825, pp. **5ab; a** reconstructed version was published in + 1878 in the *Yung-Chia Tshung Shu* by Sun I-Jang.

[1] 浴種 [2] 八輩蠶 [3] 蚖珍 [4] 柘蠶 [5] 蚖蠶
[6] 愛珍 [7] 愛蠶 [8] 寒珍 [9] 四出蠶 [10] 寒蠶
[11] 珍 [12] 愛蠶 [13] 蚖蠶 [14] 愛子 [15] 川口栄作

The *ai-tshan* should be regarded as a different type:[a] the *yüan-chen* produces 'quick eggs' which are exposed to low temperatures over a three-week period. Then they hatch in the mid-ten days of the fourth lunar month into *ai-chen,* which produce not 'dark eggs' (overwintering eggs) like the *yüan-tshan,* but a second crop of 'quick eggs' which hatch in the first ten days of the sixth lunar month into *ai-tshan.* These then lay 'dark eggs' which overwinter to the following year. In such a way bivoltine silkworms *{yüan-chen -yiian-tshan)* are turned into trivoltine ones *{yüan-chen - ai-chen - ai-tshan).*[b]

Apart from these obviously well-known and widespread types of silkworm, a quite unusual polyvoltine type is recorded in Chinese sources. In the *Wu-Tu Fu*[s] (Wu Capital Rhapsody) (i.e. the city of Chien-yeh[2] (modern Nanking)), by Tso Thai-Chhung[3] we read:[0]

For the state, the tax was the twice-ripening rice; for the localities the tribute was floss silk from the eight-brood silkworms...

In the commentary we find the Chin scholar Liu Hsin-Chhi[4] quoted. The text explains that the silkworm which pupates eight times in one year *(pa-tshan-chien*[5]*)* comes from Tongking. And a commentary by Yü I-Chhi[6] quoted in the *Chhi Min Too Shu,*[A] tells us that these eight-brood Tongking silkworms have cocoons which are weak and thin. In Chin times this type of silkworm was also known in Nan-yang[7] Prefecture in Honan province[e] and in Lin-i[8] in Kueichou, where we hear that the cocoons were small, the silk weak, but the floss of fine quality.[1] In Sui times south of the Yangtze and the Lakes, four or five crops of silkworms were obtained in one year.[g] In the reign period Thien-pao" (+742 to +756) of the Thang dynasty, I-chou[10] in Szechwan province paid trivoltine silkworms *{san-shu-tshan")* as tribute. The cocoons were firm, plump and white, not unlike those of ordinary silkworms.[11] In the reign period Ta-li[12] (+766 to +779) of the Thang dynasty, Han Ching-Hui[13], a man of Chhing-ho hsien[14] in Thai-yuan fu[15] in Shansi province, succeeded in raising winter-silkworms *{tung-tshan*[16]*)* which produced cocoons. For this he was exempted by decree from taxation for life.[1]

Having established the place where the silkworm was domesticated was China, J

[a] Amano (4), pp. 158-60; Nunome *(1),* pp. 298-303; Chiang Yu-Lung (1), pp. 432-3.

[b] Watanabe Kanji (1) has already proved theoretically that this outstanding sericultural method is correct, and he succeeded in applying it to turn bivoltine silkworms into multivoltine types.

[c] *Wen Hsiian,* ch. 5, p. 12a; see also Knechtges (1), p. 395. We have taken his translation, but have changed 'filaments' into 'floss silk', not only because floss silk is the meaning of the character *mien*[17] but also because floss silk is more likely than filaments in this particular case. For the 'eight-brood silkworm' see all the other references given in the text and Shih Sheng-Han (3), p. 258.

" *CMTS,* ch. 5, p. 5a.

[e] *Erh Ta I,* ch. 24, p. 3a.

» *Thai-Phing Tu Lan,* ch. 825, p. 5a.

[g] *Thai-Phing Yü Lan,* ch. 825, p. 2b.

» *Thai-Phing Tu Lan,* ch. 825, p. 2b.

' *Thai-Phing Tu Lan,* ch. 825, p. 2b.

i Amano (4), p. 140; Ishimori (/), pp. 3-4.

[1] 吳都賦 [2] 建業 [3] 左太冲 [4] 劉欣期 [5] 八蠶繭
[6] 兪益期 [7] 南陽 [8] 林邑 [9] 天寶 [10] 益州
[11] 三熟蠶 [12] 大曆 [13] 韓景暉 [14] 清河縣 [15] 太原府
[16] 冬蠶 [17] 絲

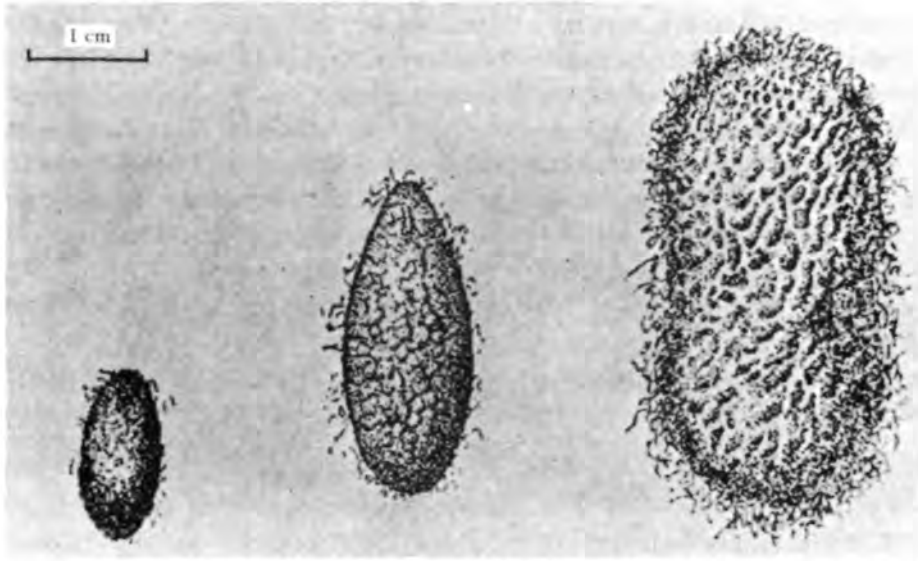


Fig. 193. Cocoons of wild and domesticated silkworms. (left) *Rondotia menciana*; (middle) *Bombyx* [*theophila*] *mandarina*; (right) *Bombyx mori*. Nunome (1), p. 67, fig. 11–3. Research on the subject was done by Moore (1), Pariset (1), pp. 57–60, Fauvel (1), pp. 100–10.

it appears appropriate to say something about the colour of cocoons and their shapes.

In all cocoons, either white, yellow, brown, grey or greenish, the fibroin is shiny, transparent and almost white. The colouring of the filament or brin is derived from the sericin which covers it.[a]

In the *Huai Man Tzu* a distinction is made between *su*[1] and *chien*[2]. The passage reads:[b]

> The natural substance of *su* (silk cloth) is white . . . the nature of *chien* (silk cloth) is yellow.. . *(su chih chih pai*. . .chien chih hsing huang*...)*

The distinction does not lie in the weave but in the original silk fibre. So at this time there were two types of cocoon distinguished, the white and the yellow, and this short passage also gives evidence that silkworms were improved and fully domesticated.[0]

We have already discussed the artificially cut cocoon which closely resembles that *oîRondotia menciana* Moore *(pai-yen-tshan*[i]*)*, found at Hsi-yin village*[1] (Fig. 194), but to facilitate a comparison of shape and size cocoons of *Bombyx (Theophila) mandarina* and the *Bombyx mori* are reproduced as well (Fig. 193).

Two cocoons of Thang date were excavated south-west of Pa-chhu[6] in the

* Silbermann (i), p. 200.
[b] *Huai Nan Tzu*, ch. 11, p. 4b.
[c] Moore (1), pp. 491-2; Pariset (1), pp. 57-60; Fauvel (1), pp. 100-10.
pp. 100-10.
[a] See above, (f), (2), (i).

[1] 素 [2] 縑 [3] 素之質白 [4] 縑之性黃
[5] 白眼蠶 [6] 巴楚

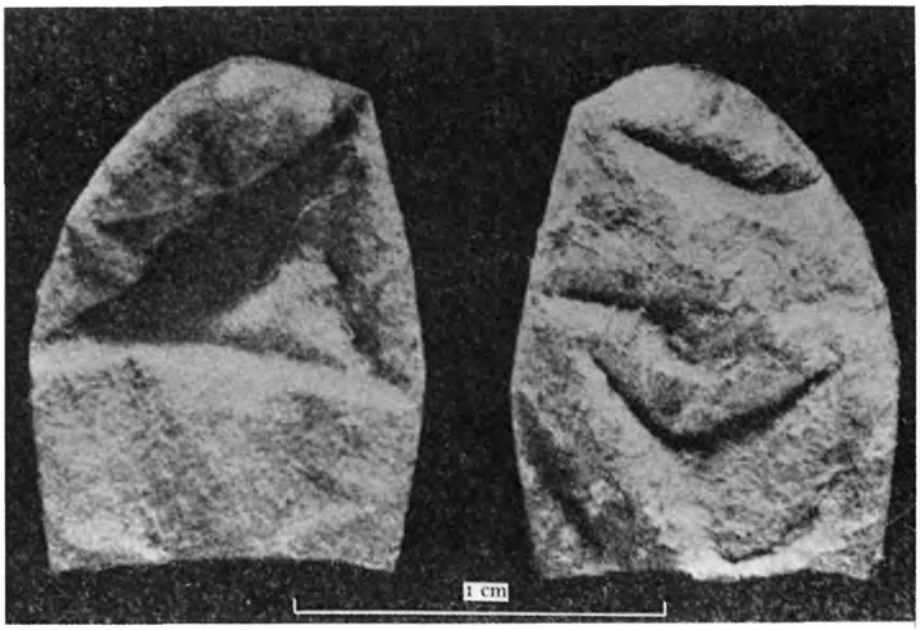


Fig. 194. The cocoon of *Rondotia menciana* of Hsi-yin village. Nunome (*1*), p. 165, fig. 11–1.

Uighur Autonomous region of Chinese Central Asia[a] (Fig. 195). From the picture published they appear to be yellow cocoons gathered after the moths had flown and they suggest that sericulture was practised in Central Asia from the time that the Han general Pan Chhao[1] was active there (+73). The earliest painting depicting silkworm cocoons was found at the Central Asian site of Dandän-Uiliq[b] by Aurel Stein (Fig. 196). According to Nunome[0] the Pa-chhu cocoons may have developed from a variety close to the *san-mien*[2] of Szechwan or the *san-mien* of Shantung. Tracing back the route by which he reached this conclusion, we can see that the varieties known as the *Kao-li san-mien*[3], *Chhing-yang** and the Ryûkyû

[a] Anon. *(743),* pi. 63; Lo Shao-Wen *(1).*

[b] Stein (11), vol. 2, pi. LXIII, D.X.4; also published in Stein (3), ill. 31. The interpretation of the panel is rather difficult. Stein (3) says on p. 64 that the panel referred to remained very puzzling for a long time. In the centre it shows a seated and richly dressed lady with a high diadem on her head, and girls kneeling on both sides of her. At one end of the oblong panel is a basket filled with what may be fruits, and at the other end a much effaced object difficult at first to interpret. The puzzle was resolved when one of them recognised the meaning of the gesture by which the attendant figure on the left points with her raised hand to the lady's diadem. It was under this diadem that the princess smuggled silkworm 'seeds' out of China. In the basket at one end of the panel are represented the cocoons produced from them, while the object at the other end reveals itself as a loom for weaving silk spun from the cocoons. More details of the story can be found in Stein (11), vol. 1, pp. 229-30 and 260.

The interpretation of the scene by Hiroshi Wada differs. He says 'The hand thus indicates not something from the source of supply, China, as was hitherto explained. This altar-painting shows a representative scene of silkworm breeding—the ritual offering of silkworm eggs to the silkworm goddess as the beginning, and weaving as the concluding act.' Wada (1), pp. 56-8.

Ohta Eizö dated the painting as +8th century, Ohta (3), p. 274. Tamara Talbot Rice suggests -(-7th century, Rice (1), p. 911, fig. 201.

[c] Nunome (5), pp. 178-83.

[1] 班超 [2] 三眠 [3] 高麗三眠 [4] 青陽



Fig. 195. *Pa-chhu* cocoons, Sinkiang, Thang dynasty. Anon. (*743*), pl. 63, length 3.2 cm, width 2 cm.



Fig. 196. Basket filled with cocoons, on a painted panel from shrine D.X., Dandān-Uiliq, *c.* +7th century. Stein (11), vol. 2, pl. LXIII, D.X.4.

variety *tanken*[1], all appear to be domesticated versions of one original Chinese strain, and all have long egg-shaped cocoons, like those excavated from Pa-chhu. These strains still survive, so in comparing them we have to ignore 1200 years of development of the cocoon's shape. Comparing these cocoons with a selection of eleven varieties (Fig. 197) from a total of 43 varieties, Nunome concluded that the Pa-chhu cocoons probably belonged to the Szechwan *son-mien* strain, or the *san-mien* of Shantung.

These cocoons date from Thang times, and may perhaps belong to varieties introduced to Central Asia when sericulture first began there under the Han. For it is unlikely that this was a region of high-level sericulture; indeed in other areas, such as the Kiangsu-Chekiang region, a superior type of silkworm had already been developed.

It seems safe to say that from Han to Thang times the number of silkworm varieties increased enormously as people repeated the rearing and selecting process.

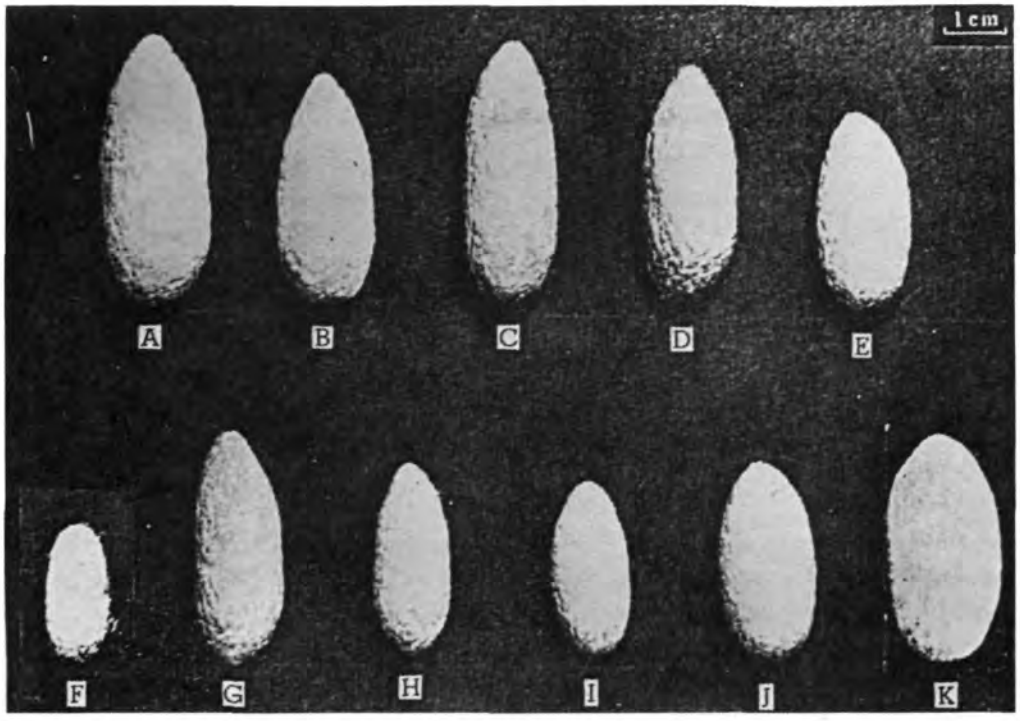


Fig. 197. Present varieties of egg-shaped cocoons. A, *Shantung san-mien* (line of Kyōsan 京蚕); B, *Shantung san-mien* (line of Sanshi 蚕試); C, *Szechwan san-mien* (line of Shimane 島根); D, *Szechwan san-mien* (line of (73)); E, *Szechwan san-mien* (line of Kyōsan 京蚕); F, *Kao-li san-mien*; G, *Ta-ju-lai* (single cocoon); H, *Ta-ju-lai* (multi-pupal cocoon); I, *Ryûkyû monovoltine*; J, *Maisōru*; K, *Chhing-yang*. Nunome (*3*), p. 181, fig. 3.

Their desirable qualities became more and more prominent and many distinct types were created.

The *Thien Kung Khai Wu* of + 1637 tells us about the colour of cocoons:[a]

Cocoons are of two colours only, yellow and white. Only the yellow kind is produced in Szechwan, Shensi, Shansi, and Honan provinces, whereas in Chia-hsing and Hu-chou prefectures only white cocoons are produced.

Amano observed that in the middle of the twentieth century the three-sleep silkworm varieties were reared in Szechwan and Shantung, the four-sleep varieties in Hupei. The spring-silkworms *(haruko*[1]*)*—which breed once annually in spring and early summer—are the four-sleep kind, and the summer-silkworms *(natsu-ko*[2]*)*—which yield two or more crops—are of the three-sleep type and are both reared in Kiangsu and Chekiang.[b]

We conclude this sub-section with a table showing estimates of the production of cocoons by province.[0] The estimated figures are valid for the years around + 1880.

[a] Sun (1), p. 37.
[b] Amano *(4)*, pp. 157-8.
[0] Exact figures are not available.
[1] 春蚕 [2] 夏蚕

Table 6. *Estimates of Annual Production of Cocoons by Provinces (c.* + 1880) (in piculs; 1 picul = 60 kg)

Province	*Lillian M. Li*[&]	*Henri Silbermann*[1']
Chekiang	825,500	1,000,000
Kuangtung	576,100	716,666
Kiangsu	275,200	353>333
Szechwan	205,800	330,000
Honan	100,800	141,666
Hupei	79,100	100,000
Shantung	24,100	45,000
Anhwei	10,800	30,000
Hunan	6,500	25,000

From these figures we may deduce that in the main areas of sericulture about 9700 to 12,600 tons of raw silk were produced annually. Yet this can only give an idea of the vast scale of silk production in which silk breeders were intimately involved, and is concerned only with silk which was obtained by traditional methods. All the same, by comparing these figures with those obtained from the tax in raw silk of + 1328, which amounted to 655 tons—less than 10 per cent of the yearly production not including fabrics and silk used privately—we may assume that the quantity of yearly silk production remained on the same level over many centuries, certainly until the middle of the 19th century. An increase in production, based on the demands of foreign markets, especially those in France and the United States,[0] led to the introduction of new technology from the West, during the last decade of the 19th century and also in the 20th century.*[1]

(3) SERICULTURAL IMPLEMENTS AND EQUIPMENT

There are countless descriptions, some in a few sentences, others in whole paragraphs, dealing with the implements used and the arrangements which had to be met in silkworm breeding. Obviously, therefore, a selection has had to be made taking into consideration the most detailed sources of high reliability as well as the textual traditions of longest standing.

The rearing of the domesticated silkworm was widespread and economically important as a cottage industry. In the majority of silkworm rearing households, this activity was just a seasonal one, mainly performed by women; the *Keng Chih Thu* depicts a typical scene of women at work in a breeding room, giving us the

* Li (1), p. 98, Table 17. The figures are based on Rondot (6), vol. 1, pp. 194-208. The figures are converted from Rondot's values for kilograms of raw silk, using the conversion formula 13 parts cocoons = 1 part raw silk.

[b] Silbermann (1), p. 263; the figures are converted from kg into piculs.

[c] Li (1), p. 84. [d] *Ibid.*, pp. 86-9, 110-11.

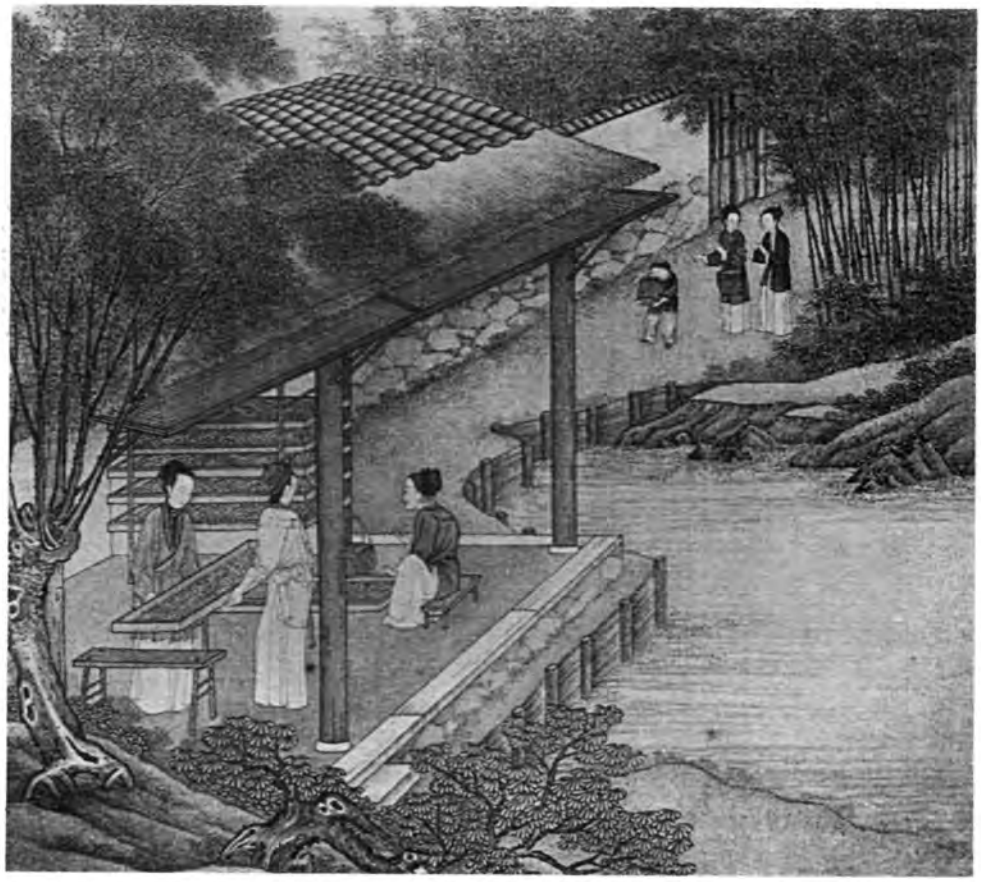


Fig. 198. Women at work in a silkworm breeding room, between +1707 and +1723. From the rare Yung-cheng edition of the *KCT*, reproduced from *KKChK*, 1933, 271, p. 563.

impression of an upper-class, if not idyllic, setting (Fig. 198). Very seldom in the 19th and 20th century were men involved in this occupation and for this reason it did not develop generally into a prime source of household income. With this pre-condition in mind we can see why the silkworm breeding houses (Fig. 199; Fig. 200)—which in most cases were no more than rooms—and the other implements were not of equal standard throughout China but differed a lot. In farming households, room was very limited and so the rearing of silkworms happened at best in a small side-room furnished with flat bamboo-baskets on a stand by a window which could be closed. On the other hand, only commercial breeders could afford separate rooms with heating and large frames to take the silkworm mats and the hurdles on which they hatched.* Most peasant breeders did not use

[a] In Japan, professional silkworm breeders developed a number of architectural improvements in the construction of breeding houses, see Kuhn (n), pp. 77-8.

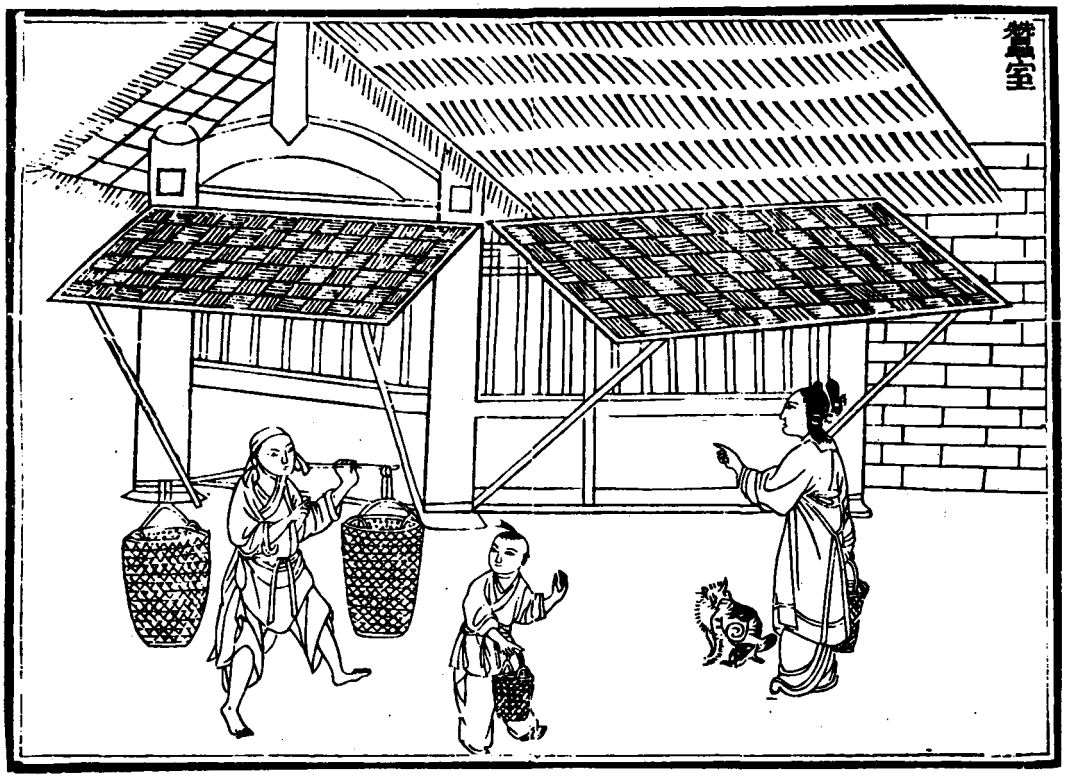


Fig. 199. Silkworm breeding house (*tshan-shih*), +1313. *NS* (+1530 ed.), ch. 22, pp. 9ab.

heated rooms because they could not afford it and this, of course, had consequences when it came to hatching.* In this connection M. Feska has shown experimentally that the breeding time of the caterpillar can be shortened when the temperature is increased from 20 °C to 25 °C.[b] Under normal conditions it takes some 34 to 35 days for caterpillars to hatch out from eggs, but under artificially heated conditions this is reduced to 29 to 30 days for the same species. A few premature species will even make it in 25 days.

So when rearing silkworms the timing of their development from egg to a cocoon in a state ready for reeling off the silk, needs careful attention, otherwise the whole crop will not develop according to the breeder's schedule and will finally give rise to financial losses. Feeding the worms had to be done frequently and copiously; if the mulberry leaves were measured out too sparsely, there was a delay of up to five days.[0] It was only logical therefore that all the implements and equipment had to be prepared prior to the breeding season.

[a] Translated from Wagner (1), pp. 430-1.
[b] Feska (1), vol. 2, pp. 812-13.
[c] Wagner (1), p. 431.

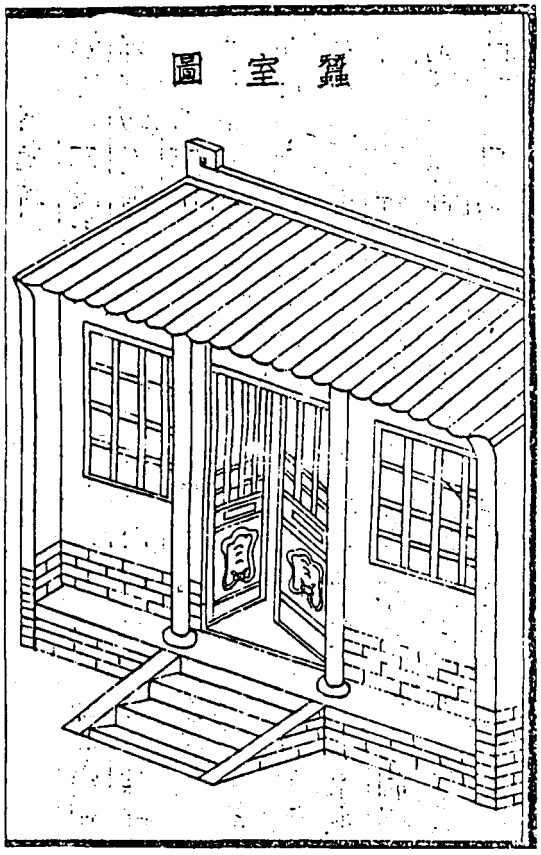


Fig. 200. Silkworm breeding house (*tshan-shih*), + 1742. *PFKI*, ch. 2, p. 20a.

In Chinese texts there are descriptions and illustrations of the following implements and breeding equipment:

stoves, *huo-tshang*[1]
framework for the silkworm mats, *tshan-chui*[2]
crossbars to take the mats, *tshan-chhuan*[3]
silkworm mats, *tshan-po*[4]
silkworm trays, *tshan-fei** or *tshan-khuang*[6]
bamboo-framed rectangular trays, *tshan-phan*[1]
stand for silkworm trays, *tshan-chia*[8]
silkworm net, *tshan-wang*[9]
silkworm ladle, *tshan-shao*[10]
spinning bell, *tshan-tsu*[11].

These are followed by descriptions of the various methods of killing the chrysalis inside the cocoon, the storing of cocoons, and silk-reeling.

[1] 火倉 [2] 蠶槌 [3] 蠶椽 [4] 蠶箔 [5] 蠶箠 [6] 蠶筐
[7] 蠶槃 [8] 蠶架 [9] 蠶網 [10] 蠶杓 [11] 蠶簇

(i) *Stoves—The Art of Heating a Silkworm Breeding House*

The temperature in the silkworm rooms and houses could never be neglected; it needed constant adjustment by the use of stoves because 'if the temperature of the (silkworm) room is uneven it would cause the worms to sleep at different intervals',* thus creating economic hardship for the cocoon producer. The oldest source including detailed instructions on silkworm breeding houses is the *Chhi Min Too Shu* of +533 to +544. It says:[b]

When preparing the house (to rear silkworms), it should have windows which can be opened on all four sides (of the house) and paper should be pasted to the bamboo wattles (forming the walls of the building) to keep the warmth.—This work is done at the time of the Chhing-ming Festival, [around 5 April.]

When the silkworms are small (just hatched out from the eggs) manure-cakes from cattle (in the shape of bricks) are put into niches (in the walls) and are burned without smoke. If there are no niches in the walls, fires are prepared according to instructions, just at the four sides of the frame with the silkworm mats.

If the temperature is not equally (warm), then the waking (of the silkworms) after their sleeping periods (essential to their development) happens at different times. Nowadays people are well acquainted with the (smokeless) fire in the silkworm breeding houses; (the former method of opposing the cold), however, consisted in burning dry wood. When the smoke which enveloped (the silkworms) was too much, then the silkworms received (a large quantity of) poison and many (of them) turned black and rotted away.

The method of heating the silkworm breeding house described here may sound rather simple but nevertheless represents an innovation: the use of cakes, made from the manure of cattle. These could be burnt without flame and with only a little smoke which compared favourably with the previous use of dry firewood.

From the *Shih Nung Pi Tung* (The Farmer's Essentials), a work of the + 12th or + 13th century, the silkworm breeder gets further instructions on how to construct a heating source. Judging from the size of the room recommended, silkworm breeding was a large scale operation, far exceeding a mere sideline.

The *Shih Nung Pi Tung* says:[c]

When building a stove in the middle of the room, one digs a hole. Its width and its depth should be adequate for the size of the room. If, for example, a house has thirteen bays in four rafter sections,*[1] then one of the (hole's) rectangular dimensions should (have)

[8] JV5[1] (+ 1530 edition), ch. 22, p. 12a; we are grateful to E-tu Zen Sun for having drawn our attention to this statement.

» *CM TS,* ch. 5, p. 6b; *NCCS,* ch. 31, p. 17b.

[c] *NSCT,* ch. 4, pp. 5ab; *NCCS,* ch. 31, pp. i8ab.

[d] A house with thirteen *chien*[1] (bays), compartments between columns and pillars that divide a building into regular parts, has a long front. Assuming one *chien* measures about 180 cm, a five *chien* front has a length of 9 m. In that case the house had a depth of 5.40 m, so it was a rectangular building with a central door. The stove may have been placed in the central bay area extending all the way from the front door to the back door.

[1] 間

a width of about 120 cm. (The size of the hole always) follows the size of the room when increasing and when decreasing.

The hole is surrounded by a wall some 60 cm high, built of unburnt bricks and plastered with adhesive clay. The whole depth adds up to about 120 cm. A layer of fine broken and dry cattle manure is spread over the ground of the hole three to four fingers thick, the manure having already been pounded in the twelfth lunar month. On top of the manure-layer, another layer of roots, knots and knotty dry fuel is spread some 15 cm or more thick, and all sorts of wood which is strong and hard like mulberry, elm and *Sophora japonica* can be used. On top of the wood a layer of manure is spread to fill the cavities in the fuel, packing it up very solidly.—One should act carefully to avoid cavities which could give rise to flames and endanger the house. (Furthermore a) fire does not last long.

Layers of manure and fuel are spread alternately until the hole is filled up completely. As a final top-layer, manure is again used to cover it thickly. About seven or eight days before the silkworms hatch out from the eggs, a fire is kindled on the top manure layer (from which) black and yellow smoke (arises) for five to seven days. One day before the caterpillars come out, the door is opened a little, so that (the smoke) evaporates completely. Then the door is closed again to prevent the warmth from escaping. The wood and manure (in this type of stove) will sink (slowly), to give perfect smouldering. . .The (stove) [described above] should have a wall about 60 cm high causing the warmth to rise (steadily) and to disperse evenly all over the room. It will also protect the people working (in the room) from falling (into the stove) by accident.. .The room should be dry and (easy) to air, its walls should retain the warmth.. .The old paper pasted to the windows should be replaced by clean white paper.

This text tells us not only about the size of a large breeding house and its equipment including the paper windows, but also reveals that apart from the heating method making use of four niches in the four walls of the house, a heating technique requiring only one centrally situated heating-source in the house was quite common. Both forms of 'fire' had to provide warmth and smoke. The warmth played an important role in silkworm growth, while the smoke was probably essential to keep away all sorts of harmful insects.

The *Nung Shu* and Sung sources tell us that there was also a portable stove (Fig. 201) :[a]

The stoves *(huo-tshang[1])* are fires placed in the niches *(khan[2])* of the silkworm breeding houses *(tshan-shih*).* In all rooms where silkworms are hatched out, niches are broken into each of the four walls,[0] (each) shaped like a triangle *(san-hsing[4])*[c] . . . Nowadays portable stoves *(thai-lu[5])* are manufactured. After the wood or manure has first been kindled outside (the breeding room, the stove) is carried into the house (by two persons).

The fire in all stoves has to be prepared and fed continuously, (it is) increased when it is cold, reduced when it is hot...

[a] **JV5, ch. 20, p. 11 a.**
[b] **The second part of the sentence is quoted from the *WPHS*, see *NCCSCC*, vol. 2, p. 929, n. 16.**
[c] *San-hsing* is also the name of a zodiacal constellation, see above p. 260.

[1] 火倉 [2] 龕 [3] 蠶室 [4] 三星 [5] 柏爐

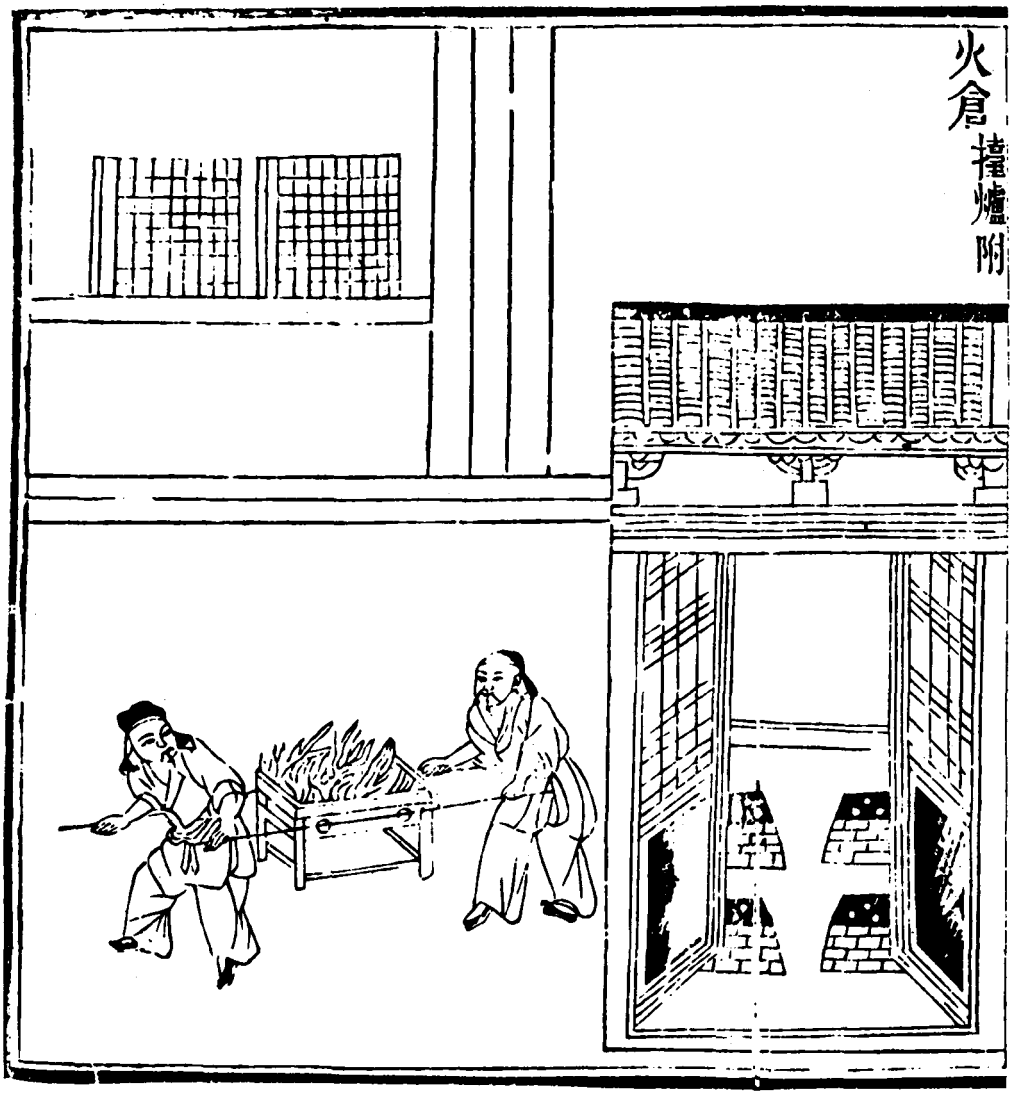


Fig. 201. Stationary stoves made of bricks (*huo-tshang*) and portable stove (*thai-lu*), + 1313. *NS* (+ 1530 ed.), ch. 22, pp. 11ab.

Wang Chen continues quoting from the *Nung Shu* of + 1149 by Chhen Fu using his paragraph 'heating the room while gathering mulberry leaves' *(jung huo tshai sang chihfa*[1]*)* :[a]

Silkworms belong to the category of fire. It is suitable to rear them with fire. When using the heating method, one should make a stove which can be carried in and out (of the breeding room). The fire should be kindled outside the room (so that the)

[8] Chhen Fu, *Nung Shu,* ch. 2, pp. 7ab; Wang Chen, *Nung Shu,* ch. 20, p. 1 ia.

[1] 用火採桑之法

warmth (can develop in the stove) which is covered with straw ashes so that no abrupt blaze of fire can arise.

Wang Chen then comments on the text by Chhen Fu :[a]

With reference to the construction of the portable stove, it has a low framework in the inside of which the portable stove is inserted. On both sides (of the stove) long handles project so that two labourers can lift it up and carry the source of heat.

(ii) *The Matting Framework*

There are many descriptions of frames, mats, baskets and trays, how they were made and used.[b] Once more we have had to select from the voluminous information available and have decided to concentrate on the tradition of the *Nung Shu,* the most authoritative source still extant.[0]

The paragraph on 'matting frames', *chui*[1], starts with a quotation from the *Li Chi* (Record of Rites), the earliest pieces of which date from about —465 to —450, and which was probably compiled between +80 and +105. 'In spring mats *{chhii*[2]*)* and frames *(chih*[3]*)* are prepared.'[d] *Chhil* and *chih* are ancient terms forjbo[4] and *chui*[5].[e] The text continues quoting from the *Wu Pen Chih Yen* (Plain Speaking about Attending to the Fundamentals in Agriculture and Sericulture), from the + 13th century or earlier and attributed to Hsiu Thing-I.[f] The *Wu Pen Chih Ten* says (Fig. 202) :[g]

In the 'grain-rain' period [beginning : 21 April] the frame posts are set up. Each of the four wooden posts exceeds the height of the pillar beams (of the house) and follows in its vertical setting-up the space available in the room. (In this way the construction of the frame uses the empty space under the gable-roof of the breeding house.) The outer sides of the wooden posts are carved like saw-teeth but deeper, to suspend rope-rings made of the inner bark of the mulberry tree. Hemp as raw material is not suitable in the silkworm business.

To the four posts two long (horizontal) crossbars are fixed. Over the crossbars rush mats are spread evenly, slightly slanting (from the back to the front). Each frame has ten suspension (rings), arranged at a distance of 27 cm from each other to take (the crossbars of) the mats. In times when the silkworms have to be carried away or have to be fed, the mats can be lifted or lowered (as required by the circumstances).

An additional explanation is given in the *Nung Sang Chih Shuo* (Plain Speaking on Agriculture and Sericulture) :[h]

[a] *NS,* ch. 20, p. na. [b] Kuhn (9), pp. 49-54.
[c] The *NCCS,* ch. 33, p. 9a quotes from the *NS,* ch. 20, p. 12 b; see also *STTH, (chhi-yung),* ch. 9, pp. I2b-i3a.
[d] Couvreur (3), vol. 1, p. 350; *Yii Phien,* ch. 2, p. 29b.
[e] Kuhn (9), pp. 49-50. [f] Amano *(8),* pp. 108-9. [g] -^5, [cn]- 20, p. 12b.
[11] *Ibid.* ; it should be noted that the contents of this short passage occur in a similar textual version which is also contained in the *NSCT,* ch. 4, p. 5b giving as references the *CMTS* and the *SNPT.*

[1] 槌 [2] 曲 [3] 植 [4] 箔 [5] 槌

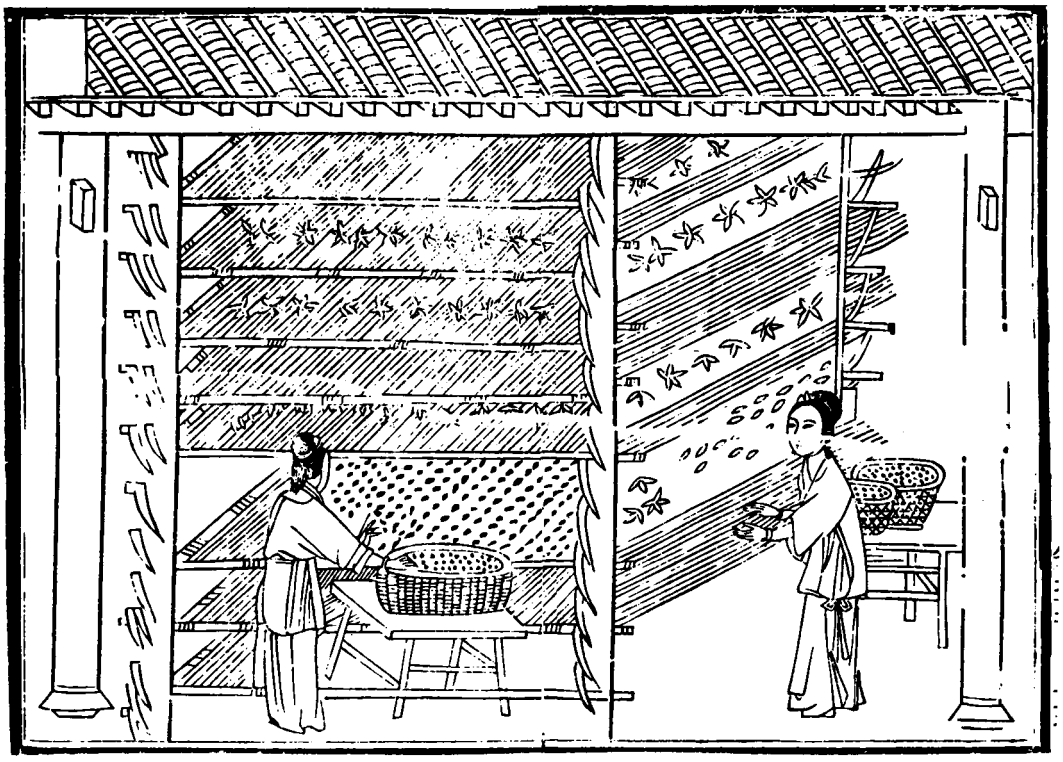


Fig. 202. Frame of silkworm mats, +1313. *NS* (+1530 ed.), ch. 22, pp. 3ab.

Each section of the frame should be divided into three spread out mats: an upper, a middle, and a lower. The upper one holds the dust, the lower one keeps the moisture away, and the middle one is to put the silkworms in order by separating them and carrying them away (if necessary).

The matting frame consisted of several structural parts—posts, the rings made of rope and the crossbars. A short paragraph on the crossbars, contained in the *Mung Shu,* may help us to imagine the whole structure:[a]

The crossbars (to take the mats) of the silkworms *(tshan-chhuan*[1]*)* are the wooden parts of the frame. Bamboo can also be used. The bars have a length of some 360 cm and are always used in pairs...

Silkworm mats *(tshan-po),* trays and baskets have a long tradition in China. As the author has pointed out elsewhere[b]/>o[2] or *wei-po*[3] are terms generally used later than Han times; they referred to a mat made of reeds which was normally explained by the character *lien*,*[0] a curtain or a screen, or as woven *(chhii-po*[5]*)* bent

[8] *NS,* ch. 20, pp. 13b; see also *NCCS,* ch. 33, p. 9b.
[b] Kuhn (9), p. 49.
[c] *SWCT,* ch. 5 *shang,* p. 3b; *Tit Phien,* ch. 2, p. 29b.

[1] 蠶椽 [2] 箔 [3] 葦箔 [4] 簾 [5] 曲薄

hurdles or mats, or as *wei-po*[l,&] rush mats, and as *chhü*[z,b] especially used for rearing silkworms. After the Han dynasty also *chhii-chkii*[3] and *kua*[4c] were common terms.

The *Nung Shu* says:[d]

The silkworm mat is a bent mat which is an implement to hold silkworms *(tshan-po chhii-po chheng tshan chiiyeh*[s]*)*. . .Chou Pho[e] made a living from weaving mats (for the rearing of silkworms).

Yen Shih-Ku[6] [+579 to +645][1] commented (on the bent mat) and said: 'Rush mats are bent hurdles.'

In the northern regions where many silkworms are raised, the peasants grow rushes *(huan*[7] and *wei*[s]*)* to obtain material for the mats. (They plant them) either behind the courtyard or in a garden. After autumn they cut and gather them so that they themselves can weave them into mats. The square (-shaped mat measures a side-length of) about 300 cm. (The mats are spread over) two crossbars *(chhuan-chan*[9]*)* which themselves are suspended from the frame-stand. When the time comes to separate the silkworms and carry them away from the mat, the rush mats are taken and easily rolled up.

In the southern region many rushes grow; peasants should make more use of them so as to spread the rearing of silkworms.

To sum up our impressions of mat-weaving we quote a few stanzas from a poem by Mei Yao-Chhen[10](+1002 to +1060)s quoted in the *Nung Shu*:[h]

During the day women gather rushes and reeds in the river,
returning home at night they weave them into mats,
used as silkworm mats, they differ very much from the bamboo-splint silkworm trays (they) made,
how many of them came into use here?...

and from another poem by Mei Yao-Chhen we may add:[1]

Mats are employed in the north, trays in the south,
both are implements for the rearing of silkworms,
but both are spoken of mutually.
When the silkworms are big in the south, one uses mats,
when the silkworms are small in the north, one uses trays,
thus their suitability does not interfere with (one) another...

It has become clear that the statements about regional use of the implements are contradictory. A final decision cannot be made here, but to judge from the

"• *Tu Phien*, ch. 2, p. 29b.
[b] Couvreur (3), vol. 1, p. 350; Karlgren (1), no. 1213a.
[c] Kuhn (9), p. 50, and table I.
" *MS*, ch. 20, pp. 13a-14a: *NCCS*, ch. 33, p. 5b.
[e] Giles (1), pp. 163-4, [no]- 422. During his political career in the Former Han Dynasty, Chou Pho became a minister of state, but when he was young he earned a living with all sorts of jobs.
' Giles (1), pp. 938-9, no. 2472.
[g] *SB*, vol. 2, pp. 761-70.
[h] *NS*, ch. 20, p. 15a.
' JV5, ch. 20, p. 15a.

[1] 葦薄 [2] 曲,笛 [3] 遽笛 [4] 篤 [5] 蠶箔曲薄承蠶具也
[6] 顏師古 [7] 萑 [8] 葦 [9] 椽棧 [10] 梅堯臣

information available it appears quite reasonable that the silkworm mat was preferred by the silkworm breeders north of the Yangtze who, before Sung times, certainly reared silkworms on a larger scale than was usual south of the river. This view is not only supported by the way the devices were made and their size, but also by the more advanced silk technology of the north, especially as far as the reeling machinery was concerned. In Sung times the crucial change took place. Northern textile technology spread into the south and soon the coastal provinces like Kiangsu and Chekiang dominated silk production and commerce.

(iii) *Silkworm Trays*

In ancient times the silkworm tray *(tshan-khuang'* or *tshan-fei[2])"[1]* was a bamboo device to contain ceremonial presents of silk *(ku sheng pi po chu chhp).* The *Nung Shu* says (Fig. 203) :[b]

Nowadays it is used to rear silkworms, and the name for it is still the same. Its shape and its make similar (to the way they were in ancient times), elliptical and shallow with a rim. So silkworms can be placed in it. One makes use of them when silkworms have to be distributed (on various trays). The trays are (arranged) in the bamboo frame-stand like shelves (at a regular distance from each other), so that they can be carried easily and the silkworms can be fed (comfortably).

Another type of silkworm tray was the 'bamboo-framed rectangular tray' *(tshan-pharfi<[5],* Fig. 204) :[c]

The bamboo-framed rectangular tray is an implement to contain silkworms. Chhin Kuan says in his *Tshan Shu:[A]* 'The eggs which needed one square foot when hatching, need forty feet square when they are about to produce the cocoons.' The trays are woven of matted reed, (and) the outer framework (is) of bamboo with a length of 210 cm and a width of 150 cm. The distance between the suspended trays is 27 cm. The frames have ten partitions to carry the trays of the silkworms and for feeding them.

Nowadays the *khuang-tray* is called *phan* and one uses a wooden framework with a coarse bamboo weave matting *(tien[6])* as the inner base. A wooden frame is used as a frame-stand.

The frame-stand should not be confused with the matting frame which is considerably larger in size. In our opinion not only wooden framed trays, as just described in the text, were used, but also bamboo framed trays as they can be found in many places in China even today.

We turn next to the question of how they were made. Trays and mats were woven in a variety of materials such as bamboo splints, reeds which are hollow

[a] *Tshan-khuang,* see JV5 (+ 1530), ch. 22, p. 16a; *tshan-fei,* see *NS,* ch. 20, p. 15a.
[b] *NS,* ch. 20, p. 15a; also contained in *NCCS,* ch. 33, p. 6b; *STTH,* ch. 9, p. 14b; *SSTK,* ch. 73, p. 9a.
[c] Kuhn (9), pp. 50, 52. *NS,* ch. 20, pp. I5b-i6a; *STTH,* ch. 9, p. 15a; *NCCS,* ch. 33, pp. 7ab; *PFKI,* ch. 2, pp. nab; *TSTP,* ch. 3, p. 12b; ch. 11, p. nab. " *TS,* p. 2.

[1] 蠶筐 [2] 蠶箔 [3] 古盛幣帛竹器 [4] 蠶槃 [5] 蠶盤 [6] 簟

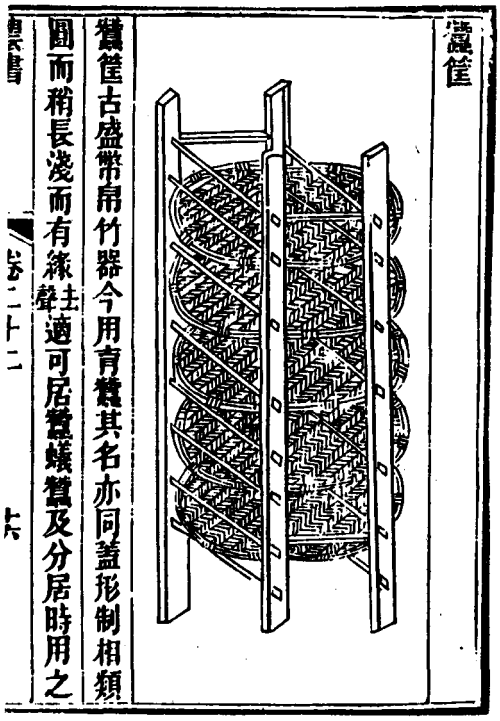


Fig. 203. Round silkworm trays (*tshan-khuang*), +1313. *NS* (+1530 ed.), ch. 22, p. 16a.

inside *(lu)*[1], withies from the willow tree *(liu*[2]*)*, grass such as the *Scirpus eriopkorum* Michx. and the *Scirpus cyperinus* var. *(khuai*[3]*)*, the *Scirpus lacustris (huan*)*, the reeds *Phragmites roxburghii* Kth. (/M[5]) and the *Phragmites communis* Trin. *(wei*[6]*)*, the *Arundo indica (lu-wei*[7]*)*, rushes such as the *Typha (mao*[4]*)* and many other plants.[8]

To judge from the illustrations handed down to us and from what we have seen in China, trays and mats in silkworm breeding, were mainly woven in a plain weave *(phing-wen pien-chih-fa*[9]*)* and in a twill *(hsieh-wen pien-chih-fa*[10]*)*.[b] These types of weave are identical with woven fabrics in their structure. They could have been manufactured on looms with a series of strings serving as warp and the material which produces the surface of the mat used as weft. But more probably the mats were made by hand without any technical equipment. According to Chinese archaeologists the plain weave type of plaiting technique was that most commonly produced, as has already been shown by the finds excavated at Pan-pho-tshun", a Yang-shao[12] site, dating from between —4225 and -4005.°

But more important than the plain weave technique in our context is the **twill,** because it was executed in the weave structures of the trays (Figs. 203, 204). This

• Kuhn (9), p. 27. [b] *Ibid.,* pp. 35-40. [c] *Ibid.,* p. 40.

[1] 蘆 [2] 柳 [3] 蒯 [4] 莞 [5] 蘆 [6] 葦
[7] 蘆葦 [8] 茅 [9] 平紋編織法 [10] 斜紋編織法 [11] 半坡村 [12] 仰韶



Fig. 204. Framed rectangular tray (*tshan-phan*), +1313. *NS* (+1530 ed.), ch. 22, p. 17a.

type oftwill pattern (herringbone) appears like the shape of the character *jen*[1]; sometimes it is also called the leaf-vein-pattern, *yeh-mai-wen*[2]. It is a characteristic pattern when the strands of the warp and the weft are of the same quality, strength and diameter.[8.] The earliest material evidence so far for this technique is reed matting from the fourth stratum of Ho-mu-tu[3], Yii-yao county in Chekiang province[1]* which is dated between —4460 and —4260.

The site of Chhien-shan-yang[4], Wu-hsing in Chekiang province, has been dated between — 2850 and — 2650. Situated in a region traditionally famous for its bamboo manufacture, it yielded several types of basketry fragments. The coarsest bamboo material woven was 2.5 cm in diameter but mostly finer qualities were used. This means that we can trace the history of mats to neolithic times. The manual traditions would have been handed down from generation to generation, and though the names changed, the practical utility of the mats made their production necessary. The manufacture of trays and mats has not changed to this day.

The silkworm trays, either round or rectangular, needed stands to hold them. From Europe we know that such stands appeared as massive pieces of furniture

[a] *Ibid.*, p. 37. [b] *Ibid.*, p. 41.

[1] 人 [2] 葉脉紋 [3] 河姆渡 [4] 錢山漾

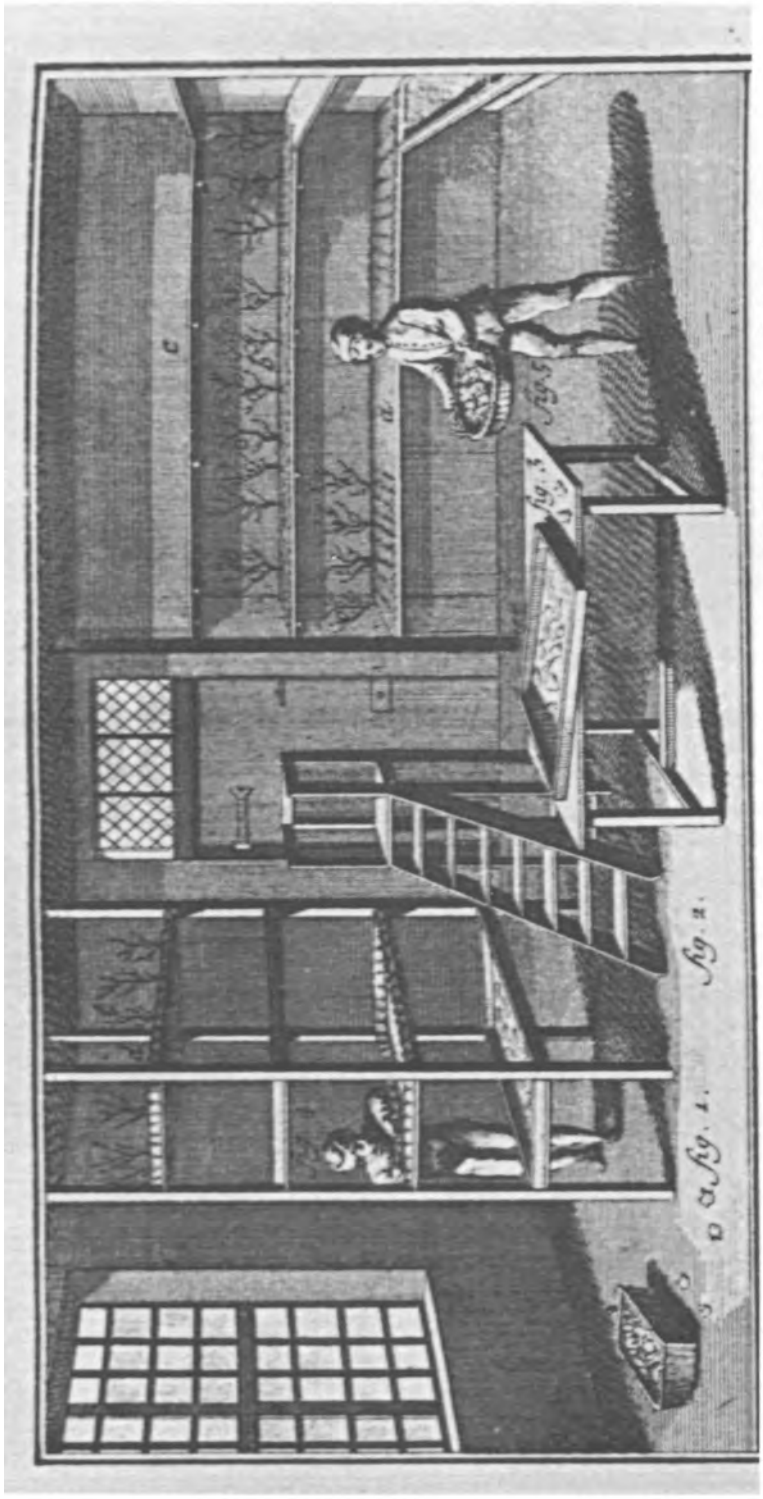


Fig. 205. Silkworm raising in a room, France, + 18th century. Diderot & d'Alembert (1, repr.), vol. I, p. 78.



Fig. 206. Feeding silkworms on hurdles, Europe, +16th century. Stradanus (1), pl. 5.

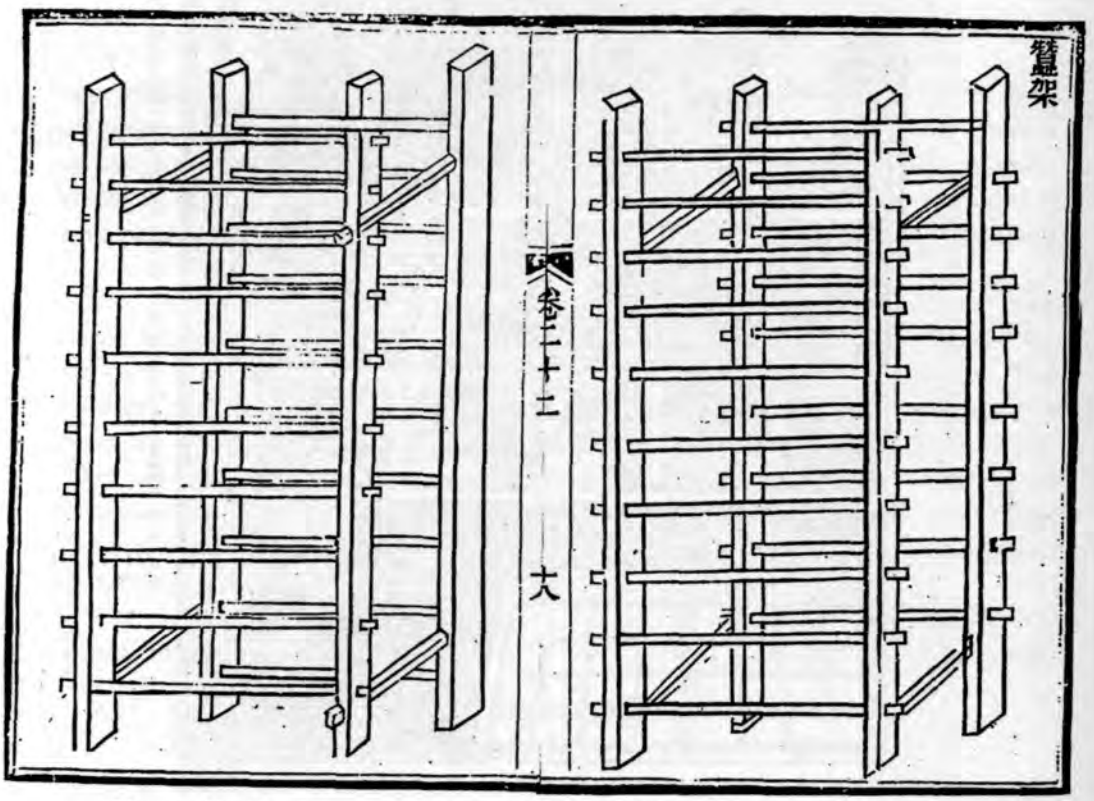


Fig. 207. Stand for silkworm trays (*tshan-chia*), +1313. *NS* (+1530 ed.), ch. 22, pp. 8ab.

(Fig. 205 ;[a] Fig. 2o6[b]), but the Chinese stands are more casual,[0] not designed as a part of the room but intended to serve a seasonal occupation. This does not imply that the stands did not have a life of many years, but simply that they lack that perfection usually given to pieces of equipment to be used in a house.

The *Nung Shu* says about the stands for silkworm trays *(tshan-chia')* (Fig. 207) :[d]

The silkworm stand is a piece of equipment on which the rectangular and the oval silkworm trays can be placed. Four slender posts are set up reaching a height of some 240-270 cm. At the top and at the bottom there are (structural) crossbars, made of bamboo (combining two ladder-like frames), which are divided into ten partitions by wooden crossbars going through the posts. The crossbars of each partition can take rectangular or oval trays (of equal size) in which to rear silkworms. (The size of the trays) must correspond to the size (of the partitions of the stand). For oval trays, small stands are used, for rectangular trays, big stands are necessary.

In the southern regions there are stands which are (light and easily made) to take the rectangular and oval trays, while in the northern regions (the wooden) frameworks take the crossbars with the matting (spread over them).

(iv) *Silkworm Nets and the Silkworm Ladle*

The descriptions given in the *Nung Shu* clearly explain the appearance of the tools and their function. There is no need for additional comments.

The silkworm net *(tshan-wang[2])* is an implement for carrying silkworms [Fig. 208]. Strings are knotted together *(chieh sheng[3])* so it is like a fishing net. When manufacturing the net its length and width must correspond to the size of the rectangular silkworm trays. For glossing, lacquer or varnish are used to make the strings firm and long-lasting. (Along the edge) the net is threaded by a net-cord *(wang-so*)* (which helps) to hold it together very conveniently. When the time has come to change (the trays) of the silkworms (for hygienic reasons and because the silkworms have grown larger), the net is first spread over them and thereafter mulberry leaves are sprinkled over it. As soon as the silkworms smell the scent of the leaves, they all creep through the holes in the net *(wang-yen[5])* to eat them. One waits until all the silkworms are on the leaves, then the net is lifted with both hands, shifted to another tray and placed on it, (so that the other) can be tidied up from the droppings (of the silkworms). Compared with the method of shifting the silkworms by hand, this labour-saving method is very superior. The silkworm breeders of the south mostly use this method; in the northern regions it is also used when the silkworms are still small.[e]

The nets were made of hemp.[f]

[a] Diderot and d'Alembert (1), vol. 1, pi. 78.
[6] Johannes Stradanus (1); reproduced in Markowsky (1), pi. 5, p. 19; Luce Boulnois (1), pi. 32. pi. 32. v
[c] See also, the stands pictured in *SILK,* fig. XI.
[a] *NS,* ch. 20, p. 17a; *NCCS,* ch. 33, p. 11a; *STTH, (chhi-yung),* ch. 9, p. 16b.
[e] *NS,* ch. 20, p. 18a; *NCCS,* ch. 33, p. lib; *STTH, {chhi-yung),* ch. 9, p. 17b. A description of the net can also be found in the *TSS,* ch. 1, pp. i8b-i9a. ' *SILK,* fig. XIII.

[1] 蠶架 [2] 蠶網 [3] 結繩 [4] 網索 [5] 網眼

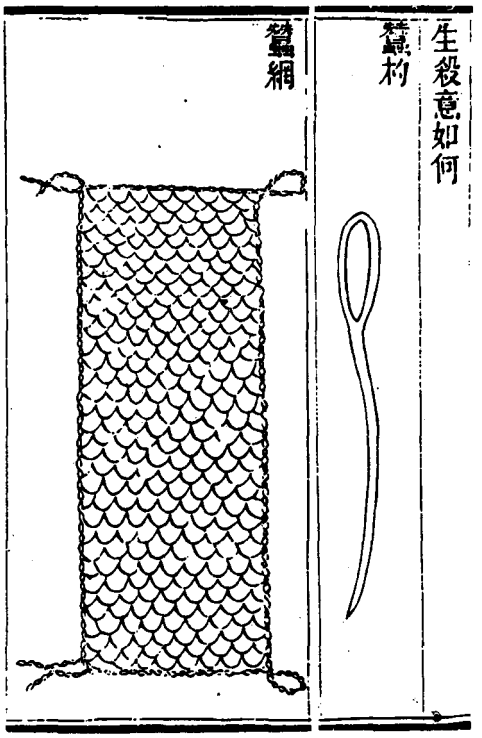


Fig. 208. Silkworm net (*tshan-wang*) and silkworm ladle (*tshan-shao*), +1313. *NS* (+1530 ed.), ch. 22, pp. 9ab, 20a.

Originally the silkworm ladle *(tshan-shao')* was a measure of capacity,[11] made of wood[b] (Fig. 208). The scoop of the ladle had the size of a cudgel, the handle measuring some 90 cm in length.

If there are empty spaces on the trays where there are no silkworms, or if the leaves which they are eating are not distributed equally on them, then you have to grasp the ladle with the help of which you can put those places in order. If the silkworms are arranged at the spinning bell, or their density is not regular, then the ladle is used to spread them equally. Supposing (the length of the handle) is not sufficient, a piece of bamboo can be fixed to it. This method is the southern custom. The (silkworm) mats and spinning bells in the northern regions are rather large (so that) the arm cannot reach everywhere. It would be desirable to take over this ladle to get the advantage of its use.[c]

The implements described so far need no further explanation, their structure, manufacture and use are obvious. It is quite different, however, with the equipment needed in the actual silk spinning process.

[1] *JVS*, ch. 20, p. 19a; *NCCS*, ch. 33, p. 12a.
» See *NCCSCC*, vol. 2, pp. 932-3.
[c] *NS*, ch. 20, p. 19a; *JVCCS*, ch. 33, p. 12a.
[1] 蠶杓

(v) *Silkworm Spinning Frames*

There are several ways of arranging the silkworms so that they can spin their cocoons. These are discussed to some extent in various works.[a]

Three main types should be distinguished, 'the mountainous straw-bundles', *shan-po*[1]^ which were tied in the middle and placed in bundles in several rows so as to support each other on the mat, with every bundle containing 60 to 70 silkworms; the 'round bell-shape', *thuan-tsu*[2,0] and the 'cube-shaped horse-head', *ma-tkou-tsu*[3]^ The round- and the cube-shaped types are supported by a structural framework inside and covered by matting on the outside. Wang Chen explains:[6]

Silkworm spinning frames *(tshan-tsu*,* literally 'silkworm gatherings').

The *Nung Sang Chih Shuo* says :

(To make) a spinning frame one uses twigs from various types of plants, pushed together with small (pieces of) brushwood and straw mats. When building the spinning frame, first its centre has to be set up. Five long sticks are used (one in the centre and four arranged at the four sides forming a tentlike shape by being) brought together at their top and bound (with a string). Around the outside (of the structure) reed mats are wound (so as to cover it completely) ; that is the centre of the spinning frame. (The central structure) is surrounded as before by twigs vertically planted at equal distances (from each other). To complete the spinning frame, reed mats are again used to surround (the outer structure) and straw mats are wound around (in such a way) that the top of the spinning frame is shaped like a round pavilion. This is the 'spinning bell' *(thuan-tsu,* literally "spherical gathering") [Fig. 209].

(Apart from this type), there is also the oblong cube-shape spinning frame *(ma-thou chhang-tsu*,* literally 'horse-head long gathering') [Fig. 210]. At both ends posts are vertically set up. The central frame consists of a horizontal crossbar on both sides. Fine (rib-like) sticks are joined to it to form the centre of the spinning frame. All the rest is made in the usual way.

This horizontal frame is the northern method (of building) a silkworm spinning frame ; it appears [to the author of the *Nung Sang Chih Shuo]* that the spinning frame in the southern regions uses only short (-cut) straw to gather the silkworms. This is spread over the silkworm trays in the breeding room. In this way people save labour and the silkworms are not damaged.

The *Man Fang Tshan Shu* (The Silkworm Treatise of the Southern Region) says:'

The spinning mat *(tsu-po)* is spread over an oblong frame made of fir or pine wood, 180 cm long and 90 cm wide. Small (pieces of) bamboo are used to make 'horse-eye'

* Western references: du Halde (1), p. 265. Julien (2), p. 183, fig. 48, pp. 144fr. Anon. (603), pp. 97-9. Reichenbach (i), pp. 87-9. *SILK,* p. 52, fig. XIV. Franke (11), pp. 168-70. Sun (1), pp. 42-3. Wagner (1), pp. 436-9. •> *TKKW,* ch. *shang,* p. 32b.

0 AS, ch. 20, p. 19b; *NCCS,* ch. 33, p. 12b; *SSTK,* ch. 74, pp. 8b-ga; *TSTP,* ch. 11, pp. i8ab.

« *NS* (+1530), ch. 22, p. 21b; *NCCS,* ch. 33, p. 13a; *SSTK,* ch. 74, pp. 9b-ioa; *TSTP,* ch. 11, pp. igab.

[e] JVS, ch. 20, pp. 2ob-2ia. The Chinese character for spinning frame *tsu* can also be pronounced *tshu. Tsu* is the older pronunciation, *tshu* is usual nowadays.

' This work cannot be traced in any agricultural bibliography, see *NCCSCC,* vol. 2, p. 933, n. 44. In all probability it is a lost work or a subtitle of a publication unknown to us.

[1] 山箔 [2] 團簇 [3] 馬頭簇 [4] 蠶簇 [5] 馬頭長簇



Fig. 209. Silkworm spinning frame, the round 'bell-shape' (*thuan-tsu*), +1313. *NS* (+1530 ed.), ch. 22, p. 20b.

(holes) close to and equidistant from each other (in the mat where bundles of) reed are inserted. Then bamboo-rods without leaves (arranged parallel to the) longer and the shorter axes (of the mat) are joined together (on the mat).

On the back of the spinning mat, a reed mat is arranged. Bamboo splinters penetrate both so as to tie them together; then the silkworms can lodge safely without danger of falling down. This is the southern spinning mat.

Actually this type of mat is no frame in the sense of a 'bell' or 'cube', just a number of reed bundles were arranged on it. This rather simple method is pictured in the + 1530 edition of the *JVung Shu*[0,] and even better in the + 1769 edition of the *Keng Chih Thu,* the illustrations of which are probably based on the + 13th century edition of Chheng Chhi.[b]

After his systematic description of all the types of spinning frame known to him, Wang Chen himself outlined the practical significance of the various methods. Being a native of the north he favoured the northern method. In his conclusions he convincingly demonstrated how far an economic importance can be attached to the various methods. We think that his thoughts on the subject are worth translating in full:[c]

» *NS* (+1530), ch. 22, p. 2iab.
[0] *NS,* ch. 20, pp. 2ib-22a.
[b] Pelliot (24), pi. XLIII.

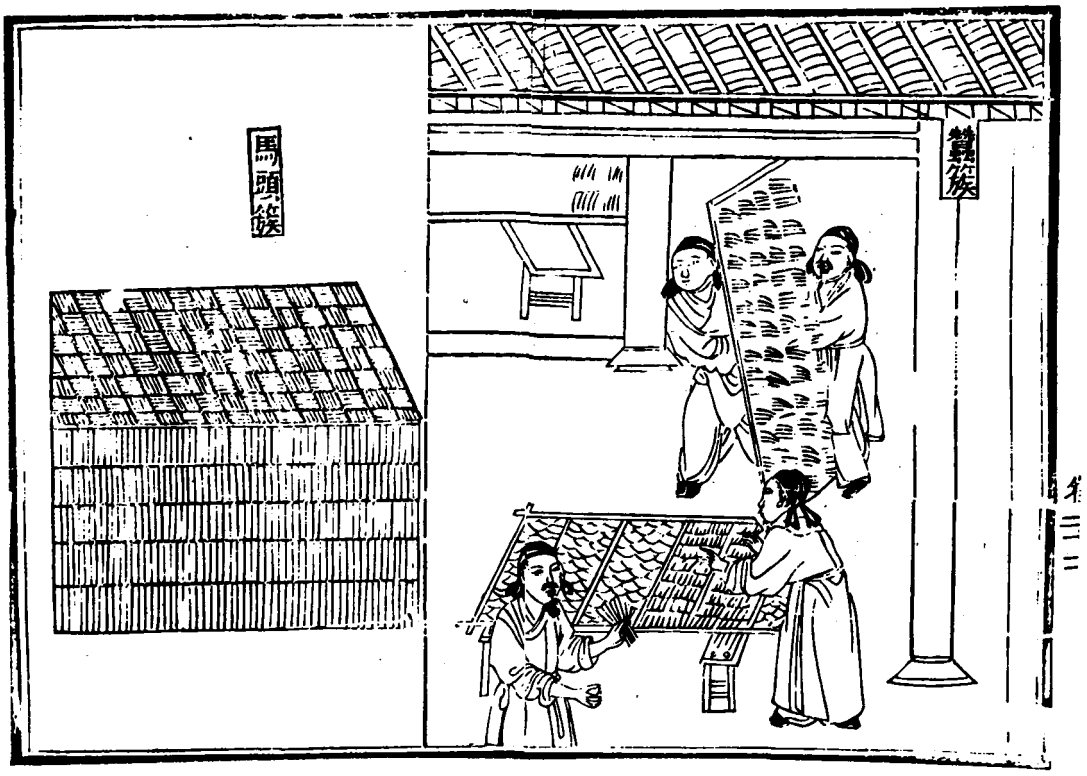


Fig. 210. Silkworm spinning frames, the cube 'horse-head-shape' (*ma-thou-tsu*; on the left side), the 'mountainous straw-bundle' (*tsu-po* or *shan-po*; on the right side), +1313. *NS* (+1530 ed.), ch. 22, pp. 20b, 21ab.

When comparing the southern method described above with the northern method (one must take into consideration) whether the number of silkworms (to be raised) is big or small, because the size (and the number) of spinning frames and whether they are difficult or easy to get depend on it. Nevertheless, if I take this occasion to discuss the matter of the southern and northern spinning frames, (I must say that) the whole (task) has not yet obtained perfection (in both regions). Why? Now, in the south the spinning frames and the silkworms are (comparatively) few, and the method employed is (technically) confined (to a minimum) - almost like a 'playing skill' - hence the profit obtained is also slight.

Although the spinning frames in the north are big, (the cases of) damage (done to the silkworms) are rather numerous. Damage due to twigs amassed (in the frames) inevitably leads to injuries through pressure. When (the frames) get wet with rain, accidents also happen, because the frames must be turned (or be substituted by others). . .[a] Again (the frames with the silkworms), whether they are inside or outside (the breeding house), are exposed to climatic changes of cold and heat; or (it may be that the silkworms) need shifting because they are arranged too high or too low, (or are) too scattered or too

• This sentence is from the *Han Shih Chih Shuo,* quoted in *NSCT,* ch. 4, see also *NCCSCC,* vol. 2, p. 933, n. 47.

close together. (All these reasons may) give rise to diseases inside the frames; if the (healthy) silkworms are few, these are the reasons.

(Because this way of handling silkworms) has been the custom for a long time, it cannot suddenly be abolished (and replaced by other methods). Recently I heard from an expert silkworm breeder of another method. The breeder figures out how many silkworms should be reared in his family (and in accordance with this number) he chooses an empty place in the courtyard (suitable for this purpose). Then beams, wood, mats, grass and other things are brought together to build a one-room shed with a ridge. Usually it can be used for various activities but when the silkworms are mature the spinning frames are placed inside it. First the centres of the spinning frames are built to the appropriate length (and in such a way that they are) hollow like tubes. (Under each spinning frame) a long groove is dug in the ground. The distances (of the spinning frames from each other) should be arranged (to be wide enough so that) the person who is to watch out for fire can walk along between them. This means (that) fire is used to heat (the shed) while the silkworms are spinning their cocoons.

The 'tube' method is not mentioned elsewhere but we may gather from what Wang Chen says that a number of regional methods were in use which are not recorded in books.

In the *Tshan Shu* (Book on Sericulture), attributed to Sun Kuang-Hsien from Szechwan who died in + 968, we are told about the heating of the room.[8] The text is quoted in the *Mung Shu* as before.

As soon as the silkworms have been- moved into the spinning frames, a charcoal fire has to be used to warm them. (The breeder) waits until they have entered their net (in the centre of which they start spinning their cocoons), then the fire is increased gradually, but without stopping in between. If it is only a little bit too cold, (the silkworms will creep around and so) the silk fibres will be floating *(j>u ssu*[1] ; and are not spun properly as is the case when the silkworms) are resting (in one place to spin the cocoons). When such fibres are reeled off (from the cocoons) they will break. So they are mostly boiled to shreds *{chu-lan*[1]*)* to make floss silk *(hsii*[3]*).* They cannot be reeled off continuously as one filament *(hsii*[4]*)* (from the beginning to the end).

From this text it is obvious that proper attention had to be paid to the cocoon spinning process because it was a 'process' which influenced the whole crop and its quality. So it is no surprise to read in the *Thien Kung Khai Wu* that spinning frames like boxes are not as good as the Chekiang method where the silk is tempered by wind and heat. In the opinion of Sung Ying-Hsing, the method of spinning the cocoons decided the quality of silk produced. In the advanced Chekiang method he sees the reason for the excellent qualities of the silk made in Chia-hsing[5] and Hu-chou[6]. The pongees of these areas last longer than those of

[8] Amano *{8),* p. 52; *SBB,* p. 96.

[1] 游絲 [2] 煮爛 [3] 絮 [4] 緒 [5] 嘉興
[6] 湖州



Fig. 211. Silkworm spinning frame 'mountainous straw-bundles' (*shan-po*), + 1637. *TKKW*, ch. shang, p. 32b.

north China, Chang-chou[1] in Fukien and other silk fabrics from Honan **and** Szechwan.[a]

What is the Chekiang method? The *Thien Kung Khai Wu* (The Exploitation of the Works of Nature) of + 1637 says:[b]

The (Chekiang) method uses split bamboo mats *(hsi chu pien po*[2]*;* equipped with straw cocks," also named cocoon holders'[1] or as we suggested from the title of the illustration *shan-po*[3], 'mountainous straw-bundle') [Fig. 211].

(They are placed) on the lower horizontal bars of the framework which is about 180 cm high. Under (the mats) on the ground, braziers with burning charcoal—which

[a] See *TKKW*, ch. *shang*, p. 28b; see also the annotated translation into colloquial Chinese of the *TKKW* by Chung Kuang-Yen *(1)*, pp. 70-2.
[b] *Ibid.* [c] Sun (i), p. 42. [d] Li Chhiao-Phing (1), pp. 59-60.

[1] 漳州 [2] 析竹編箔 [3] 山箔

should be of an explosion-free quality—are arranged in a row at a distance of about 120-150 cm from each other. When the silkworms first mount the straw-bundles, the fire is still kept low. When the worms start to spin out the silk, they are induced by the warmth of the fire to stay at the same spot instead of wandering around. When the fibre has been produced, the fires should be increased by half a catty of charcoal into each brazier. Then the spun out silk *(thu-chhu-ssu*[1]*)* dries very quickly, and (its quality) is long-lasting and does not rot (easily). The roof of the cocoon room should be built with a high ceiling, because while the lower part of the room must be warm, the upper part should be kept cool... The labourers who make the straw-bundles which are secured on the mats must have very strong hands. (At places where) the mat made of bamboo (has) an open texture, short cut straw is spread over it in order to prevent the silkworms from falling to the ground or into the fire.

Although many regional distinctions can obviously be found in regard to the silkworm mats and trays, and their stands and frames, there is no doubt that they were all used contemporaneously. The matter is different with silkworm spinning frames of the various types. Here we have found that a northern method can be distinguished from a southern method. This distinction was made at least as early as Sung times, and is nothing new but merely emphasises the general importance of regional technical skills and developments. But apart from this, the Chinese and western sources mentioned above make it clear that the Chekiang method, as it was already outlined in the *Nan Fang Tshan Shu,* prevailed and, by the end of the Ming period, was regarded as the most efficient and safest method. It may have taken several hundred years, of course, to spread to all the sericultural regions of China, but from our present day point of view we may say that almost all spinning frames today are arranged according to the Chekiang method or one very close to it.

If the *Nung Shu* and the chapter on spinning frames had not handed down to us illustrations of the other two main types—the 'spinning bell' and the 'spinning cube'—we should surely have had considerable difficulty in understanding the descriptions provided, and it would be almost impossible to imagine the reasons why they disappeared in the course of time.

(4) STORING COCOONS—KILLING THE CHRYSALIS INSIDE THE COCOON

According to the *Nung Sang Chih Shuo* (Plain Speaking on Agriculture and Sericulture), a lost work of the + 12th or + 13th century by an unknown author, but most probably compiled in the Huang-ho region,[8,] and according to the *Shih Nung Pi Tung* (The Farmer's Essentials), yet another work by an unknown author,[b]

[a] The *NSCS* is discussed in Amano *{8),* pp. 107-8.
[b] The *SNPT* is discussed in Amano *(8),* p. 107.

[1] 吐出絲

compiled at the same time in north China, the killing of moths inside the cocoons for the purpose of storage could be effected by the following three methods.[8.]

Reeling the cocoons alive is best. If there are not enough labourers at hand, (the moths in) the cocoons are killed, so that there is no hurry to reel them off.

There are three methods of killing the moth in the cocoon: firstly, drying by sunlight *(jih-shai*[1]*)*, secondly, damping with salt *(yen-i*[2]*)*, thirdly, steaming in baskets *(lung-cheng*[3]*)*. The steaming method is the best, but it is not mastered by many of the labourers. Drying by sunlight easily injures the cocoons, and damping with salt is the most recommended method.

In this short passage the answer to the question of why it was necessary to develop methods to preserve the cocoons is given in a nutshell. But perhaps we should try to explain the circumstances more precisely.

Generally it was of great economic advantage to the silkworm breeder that he had enough experienced workers and silk-reels at hand at the very short but most favourable time just before the moth tried to break through the cocoon. But because most of the silk was produced on a relatively small scale in families, the most advanced reeling facilities to produce first class grège were not available to family breeders at the peak season, and rather primitive hand-driven silk-reels were used.[b] These could only produce the uneven, elliptical silk threads, called *natives* and *tsatlees*[0] in the 19th century. Both were well-known products of Chinese cottage industry and are normally defined as being reeled from living cocoons. However, as reeled silk had a higher price on the silk-market than cocoons, many breeders chose to store them until a high-quality reeling-device was easier and cheaper to obtain than it had been in the main season. (These frames were most probably hired from the landlords.) This is where the cocoon-preserving methods came in.

Those breeders, who could not reel off the cocoons in the main season, needed a means of killing the moth inside the cocoon and of storing the cocoons. Of course, it meant additional expense for hired hands employed just at the right time, and also for jars, bamboo baskets and trays. In addition, a storehouse or a room had to be prepared as well.

» The text of the *JÏSCS*, quoted in *MS*, ch. 20, p. 23a and the text of the *SNPT* quoted in the *NCCS*, ch. 31, p. 35a and in the *NSCT*, ch. 4, p. 14a, are identical apart from a few characters.

[b] Amano *(9)*, pp. 104-7; Allom and Wright (1), vol. 2, pp. 8-9; hand-driven silk-reels from Japan and Korea are pictured in: Bavier (1), figs. 1, 3; Schwarz (3), p. 2145; Anon. (607), pi. 14.

[0] The origin of the term *'tsatlee'*, in Chinese *chhi-li**, is unknown, see *SILK*, p. 122. It was a term used in the silk export business in the 19th century, see Williams (1), p. 136. Prof. Sun wrote in her letter to us of 30 July 1984, that before the coming of steam filatures, '*Chhi-li silk*' was considered high quality silk from the Lake Thai region, and much of it was exported during Chhing times. The 'high quality' grading of fashionable merchandise for the European market does not contradict the statement that the silk threads themselves were found to be uneven in quality when technically analysed. Standards of quality are not absolute, especially where fashion is involved.

[1] 日曬 [2] 鹽浥 [3] 籠蒸 [4] 七里

The practice of killing the chrysalis or the moth—depending on the morphological state—must have been widespread[8,] and probably not only for economic reasons, for we find the method of steaming described in sericultural works from the Sung to the Chhing[b] and, for that matter, it is still practised today. The earliest pictorial evidence which may be interpreted as the steaming of cocoons has been found on a mural painting in a Sung tomb, dating from + 1075 in Tsinan, Shantung province.[0]

(i) *Steaming Cocoons*

To explain how and in which cases steaming of the cocoons was carried out, we need to refer to the descriptions provided in a few lost works from the + 12th and + 13th centuries which are fortunately quoted in the *Nung Shu* of + 1313 and in the *Nung Cheng Chhüan Shu* of + 1639. To these we have added a few sentences from the *Tshan Sang Tshui Pien* (General Compendium on Sericulture) of +1899 by Wei Chieh when it seemed to be essential for a better understanding.

The *Han Shih Chih Shuo* (Plain Speaking by Mr Han), the original title of which is *Chung Shih Chih Shuo* (Plain Speaking on Planting)«[1] of the +i2th or +i3th century says :[e]

When the silkworms have finished their cocoons and they are hard and the striped fibres coarse, then they need to be reeled off quickly. This kind of cocoon should be steamed *(cheng-liu)*[1]. If the cocoons are thin and the striped fibres are fine, then the fibres are reeled off out of the cold water basin *(leng-phen*[2]*).* There is (then) no need to reel quickly and the cocoons should not be steamed.

At first sight it appears that the Chinese author distinguished two types of cocoons, the coarse and the fine, which had to be treated differently. Yet closer examination makes it seem that he surely meant something else. What he was talking about was the appearance of the cocoon's texture in various stages of maturity. For instance, when 'the striped fibres are coarse' the moth will soon break through the cocoon and something has to be done about it; on the other hand 'when the striped fibres are fine' there is no hurry and the cocoons can be reeled off, which means there is still enough time to get a reeling-frame.

» Shih Min-Hsiung (j), p. 29, is of the opinion that the practice of killing the chrysalis in the cocoon was not widespread. We do not know on what sources his opinion is based but we can only accept it for the period after the introduction of the steam-powered silk-reeling machine, especially after + 1880, when several filatures were well established in Canton and Shanghai. According to the record of *SILK,* p. 70, the first filature for reeling silk by foreign machinery at Shanghai was established in + 1862, and closed down in + 1866 (see also Li (1), p. 164) ; the second worked only for a few months in + 1866, and the third was started in + 1878 with satisfactory results. Shih does not give the source for his date of + 1877 as the year when steam-powered silk-reeling was introduced to Shanghai.

» *MCS,* in *MS,* ch. 20, pp. 253b; *MCCS,* ch. 33, p. 16b; *STTH, (chhi-yung),* ch. 9, p. 22b; *PFKI,* ch. *2,* p. 48a; *TSCT,* ch. *thu-shuo,* p. 20a; *TSTP,* ch. 4, p. 18b.

[c] Anon. *{751),* pp. 78-9. [a] Amano *(8),* pp. 106-7.

[e] *MCCS,* ch. 31, pp. 37ab; *SSTK,* ch. 74, pp. 1 ib-i2a.

[1] 蒸餾 [2] 冷盆



Fig. 212. Steaming cocoons in cocoon-steaming baskets (*chien-lung*), +1313. *NS* (+1530 ed.), ch. 22, p. 25a.

How was the steaming of cocoons carried out? The *Tshan Sang Tshui Pien* describes the process :[a]

First one takes one *Hang* of salt [37.30 g] and five *chhien* of oil *[c.* 18.5 g] and pours them into the hot water basin. Then the steaming basket is placed over the basin. With soft straw a ring-shaped gasket is formed to insulate the opening of the basin.

Here we may continue with a passage from the *JVung Sang Chih Shuo* and contained in the *Nung Shu* explaining the handling of the steaming baskets :[b]

One uses three shallow baskets *(chien-lung*[1], mostly made of coarsely woven bamboo

[a] *TSTP,* ch. 4, p. 18b.
[b] *JVS,* ch. 20, pp. 25ab; *NCCS,* ch. 33, p. 16b; *STTH, (chhi-yung),* ch. 9, p. 22b.

[1] 蒸籠

but dense enough to retain the cocoons). . .[a] In the baskets the cocoons are equally distributed up to a thickness of three fingers. One should frequently test (the heat) with the back of the hand above the cocoons. (If the steam is very hot) and one cannot bear it, the lower basket and the top basket should be exchanged. In this way they must be changed, up and down, which makes it essential to use (three) baskets. If the cocoons are steamed too much, the ends of the fibres *(ssu-thou[1])* will become soft, if steamed too little the moth could perforate (the cocoon). The hand which cannot bear the heat is the criterion by which to judge a proper steaming. This is the way to steam cocoons in baskets.

Then from the *Tshan Sang Tshui Pien* we learn :[b]

When many baskets have been steamed, and (therefore) water has to be added, then also more salt and oil are poured in, to prevent the steam from drying the ends of the silk fibres. When the steaming is finished, the cocoons are spread out on hurdles and one waits until they are cold. Then small willow withies are used to cover them.

The fire to heat the water was under the pan or the basin in a type of stove. The chimney was either high or far removed from the work site so that the smoke could not affect the working process. Though there is no textual evidence to prove it, we may assume that this type of stove was more or less identical with that employed in the reeling process.

Without doubt steaming used to be the most common method, and was so effective that it survived until today. The illustrations depicting the technique (Fig. 212) are self-explanatory.[0]

(ii) *Damping Cocoons*

Apart from the steaming method, two other ways of killing the moth inside the cocoon were practised by Chinese silkworm breeders: drying by sunlight and damping with salt. The first constituted a danger for the silk which easily suffered from sunlight, and Chinese breeders did not favour it. As far as damping was concerned, the situation was quite different. In the + 10th century damping of cocoons is already mentioned in the *Tshan Shu* (Treatise on Sericulture), a lost work from the Five Dynasties, written by Sun Kuang-Hsien. The passage is quoted in the *Nung Shu* (Fig. 213) :[d]

Whenever you damp your cocoons *(i-chien[1])*, arrange large jars *(weng[3])* on the ground. At the bottom of these jars first place a framework, made of bamboo; then you

» Kuhn (9), p. 68. » *TSTP*, ch. 4, p. 18b.

[c] JVS, ch. 20, p. 24b; *JVCCS*, ch. 33, p. 16a; *STTH, (Mi-yung)*, ch. 9, p. 22a; *PFKI*, ch. 2, p. 48a; *TSTP*, ch. 11, p. 32a.

" JV5, ch. 20, pp. 25ab; a few sentences are quoted not only in the *MS* but also in later agricultural **works** and encyclopaedias : *STTH, (chhi-yung)*, ch. 9, p. 21b; *NCCS*, ch. 33, p. 15b; see also Franke (1 i), pp. 171-2; Julien (12), p. 159; Reichenbach (1), pp. 89-90; Anon. (603), pp. 99-100.

[1] 絲頭 [2] 浥繭 [3] 甕



Fig. 213. Cocoon jars (*chien-weng*) used for the storing of cocoons, + 1313. *NS* (+ 1530 ed.), ch. 22, p. 24a.

cover it with the leaves of the *Pawlownia tomentosa,*[3] and place on it a layer of cocoons with a weight of about 10 pounds. Sprinkle them with two ounces of salt; then you cover them with (a layer of) leaves from the *Pawlownia,* and thus you go on separating them layer after layer until the jar is full. Thereafter you close it tightly, using mud to seal it. After seven days, take the cocoons out and reel them off. When you change the water frequently, the silk is glossy and comes off easily. It is because the cocoons are numerous (and the silk) cannot be obtained by reeling (at that time) that people use salt to store them (by which) the moths will be prevented from coming out; the silk of (such) cocoons is pliable but strong and glossy and equally fine. This is the method of damping cocoons *(yen-chien-fa*[1]*)* from the southern regions which requires, however, many jars that may not be always available.

* *Thing*[1] is the character given in the text, *Pawlownia tomentosa* (Thunb.). In the poem of the *KCT* we find *wu-thung*[3] *Sterculia platanifolia,* see Bretschneider (i), vol. 2, pp. 350-1.

[1] 淹藲法 [2] 桐 [3] 梧桐

Hsü Kuang-Chhi, author of the *JVung Cheng Chhiian Shu* realised the essential conditions for a successful suffocation and hence commented :[a]

When salt comes into contact with the cocoons, it sometimes renders them damp; on this account people nowadays merely put their cocoons into the jars, and then use some paper, bamboo or lotus leaves to wrap up a couple of ounces of salt, which they place on top of the cocoons. This method will also do. Only the mouths of the jars must be well stopped up, so that no air escapes; if this be done, it does not matter what is put into the jar; never mind salt, even mud will do.

This comment suggests that in practice salt was not necessary for killing the moths inside the cocoons, only ventilation to the air had to be prevented. If this condition was fulfilled, the quality of silk of the cocoons was preserved. In a series of scientific tests executed between 1974 and 1975 Nunome Junrô tried to find out the effects of the damping technique on the quality of the silk. He found that not only was it effective in killing the pupae but also that the percentage of reelable silk was much better, and its strength and elongation superior, compared with the hot air method in use today.[b]

Though the damping process is mentioned in a number of Chinese works,[0] it does not mean that this technique of storing cocoons *(chiao-chien[l])*[&] was either suitable everywhere or widespread. The cheaper and faster method of steaming was a technique that, as far as we can trace, probably spread from Shantung to south and west China, and then remained in use throughout all China until the end of the Chhing dynasty. In rural areas the method has still survived and even today with industrial silk production a type of steaming is applied in silk filatures. This is not the case with damping which obviously originated in southern China and then disappeared during the Chhing.

From the quantity of the pictorial evidence we get the impression that damping played a more important role in the processing of cocoons than did steaming; this is incompatible with the historical development. Yet both because damping has been lost completely and in view of its technical and historical importance, we should look closely at the illustrations of this method (Fig. 214).

The woodcut from the Japanese *Keng Chih Thu* (Pictures of Tilling and Weaving) in the + 1676 edition by Kanô Einô[2],[e] which was based on the + 1462 edition of the civil servant Sung Tsung-Lu[3f], with its preface by Wang Tseng-Yu[4],[g]

[a] *NCCS*, ch. 33, pp. I5b-i6a.

["] Private communication, i May 1984. See also Nunome *(1)*, pp. 305-6.

[c] *KCT*, pi. LXXXII, in the publication of Franke (11) entitled 'Das Verwahren der Cocons', pi. XLIX in Pelliot (24), 'On enterre les cocons'. The poem is translated by Franke (11), p. 132; other works are the *SSTK*, ch. 74, p. 13a; *STTH*, (chhi-yung), ch. 9, p. 21a.

[d] Illustrations of 'storing cocoons' can also be seen in the *PMTT* of +1593, p. 12b, discussed below; also in the Ming popular-encyclopaedic work *PTHHCTof* + 1607, ch. 20, p. 13b, see Kuhn (2), p. 363, ill. 13b.

[e] Laufer (21), pp. 97-106; Franke (11), p. 76; Pelliot (24), p. 47; Kuhn (2), p. 339.

[1] Pelliot (24), p. 74, no. 2: 'Je n'ai vu mentionner cette édition de 1462 par aucune bibliographie chinoise.'

[g] Franke (11), p. 73; Kuhn (1), pp. 69-70.

[1] 窖藏 [2] 狩野永納 [3] 宋宗魯 [4] 王增祐



Fig. 214. Storing cocoons, on a handscroll attributed to Liang Khai, first decade of the +13th century. By courtesy of the Oriental Department of the Cleveland Museum of Art, Cleveland, Ohio. (Purchase, John L. Severance Fund; no. 77.5, detail of section 3.)

represents one of the oldest pictorial traditions of the subject.[a] The pictorial execution of the print is very simple. It shows a number of large jars covered with straw. Two men standing in front are discussing matters. One of the two holds a steelyard and is weighing a basket filled with cocoons. The scene indicates that unreeled cocoons constituted an important trading article,[b] which was traded by weight, as was still the case in the present century (Fig. 215).

Most of the illustrations depict a precisely similar situation, though this does not explain the storing described in the text accompanying them.[c]

The illustration in the *Pien Min Thu Tsuan* (Collection of Pictures for Ordinary People) of +1593 must also be seen in the *Keng Chih Thu* tradition. It shows female workers storing cocoons,[d] and the only indication that something like a damping process may have been performed is again three large jars covered with straw. The illustration of the Japanese *Keng Chih Thu* edition of + 1676 is certainly

[a] On the connection between *KCT* and *NS* see below, p. 344.

[b] Tietze (1), p. 20, in his study on Szechwan between the +7th and +10th centuries has pointed out that a silkworm market existed in Chheng-tu at the end of the +8th century. A silkworm trade was unheard of in other regions of China.

[c] Franke (11), pls. LXXXI, LXXXII; Pelliot (24), p. XLIX.

[d] *PMTT*, ch. 1, p. 12b.



Fig. 215. Weighing and trading cocoons in a village near Shanghai, *c.* 1902. Wilshusen (1), p. 93.

closer to the artistic style of the + 15th century than the quite elaborate and decoratively executed picture of + 1593.

How the damping of the cocoons was executed cannot be seen from the pictures. Significantly, perhaps, the illustration in the *Shou Shih Thung Khao* of + 1742 bears the title 'selecting cocoons' *(tse chien*[1]*).*[a]

We find another important pictorial tradition in the *Nung Shu* of + 1313, and it is safe to say that there are connections between the illustrations of this book and the *Keng Chih Thu.*[h] Most probably well before + 1313 Wang Chen knew one or all of the illustrated editions of the *Keng Chih Thu,* either that published by Wang Kang[2C] with a preface by Lou Shao[3], and dated as being from + 1237, or **the** one by Chheng Chhi[4],[d] dating from about + 1275, or both of them. Wang Chen's knowledge and acceptance of the *Keng Chih Thu* illustrations would explain **the** astounding similarity of the pictures. We may therefore conclude that the illustration 'damping cocoons' originally came from the *Keng Chih Thu* and had been

[a] *SSTK,* ch. 74, p. 13a. [b] Kuhn (4), pp. 143-52.

[c] Wang Kang, see Pelliot (24), p. 72: 'Il paraît bien ressortir de la biographie de Wang Kang au Song-che (ch. 408) que ce fonctionnaire lettré ne survécut guère à sa retraite, prise en 1228.' Lou Shao was a descendant of Lou Shou, see Franke (11), p. 72.

1 Chheng Chhi lived between *c.* + 1250 to *c.* + 1320; see Hummel (23), p. 219; Pelliot (24), p. 86; Franke (14), p. 184.

[1] 擇繭 [2] 汪綱 [3] 樓杓 [4] 程棨

taken over in all the subsequently published works of an agricultural or encyclopaedic character dealing with the subject.[8.]

After having experienced the difficulty of how to verify the damping process of cocoons from the pictures in agricultural works, we must turn to a handscroll attributed to Liang Khai[1b] and traditionally dated as being from the first decade of the + 13th century. The depiction of the various tasks in silk processing appears to be accurate and reliable as will become evident when we discuss the silk-reeling frame.

The section of the handscroll shows three working steps : selecting, weighing and storing.[0] Apart from a labourer weighing a basket with cocoons, three adults and a child are seen selecting cocoons and placing them in various baskets. In a neighbouring room at the back stand two large jars filled with cocoons, one covered with straw, the other uncovered. Whether or not the workers used salt cannot be decided (Fig. 214).

We conclude these observations on storing techniques with the text from the + [1]739 (?) edition of the *Keng Chih Thu*[A] in which all the essential features are mentioned :

Almost half a month after gathering the cocoons, the moths appear;
when they break through the cocoons and fly away, then you cannot reel the silk any more;
in Chekiang many silkworms are reared, and continuously by day and night the reeling is done;
fearing that the work cannot be finished completely, cocoons are placed in deep jars;
this is called storing cocoons;
because changes in the nature (of the cocoons) are accelerated by warmth, retarded by cold,
one makes use of the cold when storing cocoons.[e]

(5) SILK-REELING

We should like to start this section with a quotation from the *Shih Nung Pi Tung* (The Farmer's Essentials) of the +12/13th centuries. In its first sentence it expresses our very intention; to collect material and analyse it. The author's aims and outlook differ from ours, but the general ideas behind them are still significant

» *NS*, ch. 20, p. 22b; *NCCS*, ch. 33, p. 15a; *STTH, (chhi-yung)*, ch 9, p 21a; *SSTK*, ch 74, p. 13a.

[b] The handscroll is preserved in the Oriental Department of the Cleveland Museum of Art, Cleveland, Ohio; published in: Anon. (604), pp. 78-80.

[c] The handscroll is traditionally considered to be the probable pictorial source for many *Keng Chih Thu* editions which followed; see Anon. (604), p. 79.

[d] The prose text was already translated into German by Franke (11), p. 132.

[c] In this case it was not a question of 'retarding' which could be effected only for a few days. The moth inside the cocoon was killed by the various storing techniques.

[1] 梁楷

and may be regarded as valid even today, some 800 to 900 years after the passage was composed :[a]

If somebody collected the essentials and the wonderful techniques of the silk-reeling business in the south and in the north and wrote a book about it, it could be taken as a manual to be followed. Learning from it the most suitable methods, silkworm breeders would gain perfection year by year. With regard to one's betters, it may increase the wealth in the storehouse of the government treasury and looking at the inferior people, it may provide floss-silk and silk for them to make winter garments. There is nothing greater than opening up the source of these advantages.

Silk-Teeling means taking up the ends of several fibres and combining them into a thread. As we have already seen, each of the fibres consists of twin filaments, known as brins, gummed together by sericin. It is these which make up the cocoon, being spun in a figure-eight form by the caterpillar before it is transformed into a chrysalis. Silk-reeling takes place just before the moth tries to break through the cocoon. This timing is crucial if ' endless ' silk threads are required. The length of the cocoon-filaments which can be obtained varies between 700 to 900 m,[b] but without a silk-winding instrument, a reel, and a water basin in which to float the cocoons, silk-reeling cannot be performed.

We have also pointed out in which way the existence of the reel influenced the development of spinning technology in Ghou China, but unfortunately the beginnings of Chinese silk-reeling still lie in the dark. Although the neolithic site of Chhien-shan-yang, Wu-hsing, in Chekiang province, which is considerably earlier than the Shang period, yielded several fragments of silk, and an artificially half-cut cocoon was excavated at the prehistoric site of Hsi-yin-tshun in south Shansi, and several fragments of Shang silk could be traced on vessels and weapons,[0] we still do not know how silk-reeling was performed in the neolithic and in Shang times. Fortunately there is no alternative to reeling if a continuous filament—and not a spun yarn—is wanted, so it is clear that a reel was needed.

There are Shang pictographs written in various ways (Fig. 216) which may be interpreted as being concerned with silk-reeling. In the opinion of Chinese scholars, they show hands arranging silk threads on a reel-shaped device to take the silk; in short they picture working a silk-reel by hand.[d] The elements of the pictographs comprise two hands, a simple reel-shaped instrument and a figure-eight shape which may either be a hank resulting from reeling silk, or a sort of cocoon with silk wound around it in a figure-eight. Sun holds the opinion that the pictograph depicts two cocoons being reeled at the same time.[6] These elements and their composition in the pictograph make acceptable the hypothesis that a task closely connected

» *SNPT,* quoted in *NCCS,* ch. 31, p. 14b.

[6] For more information, see *GTL,* vol. 2, pp. 355-64; Suzuki Saburö (/); Nunome (/). In China we have heard of silk filaments with a length of 1600 m.

[c] See above, ch. *(f).* (2).

[d] JungKeng *(3),* pp. 507-9; Anon. *{644),* PP- [22]5-6> [n]- 12; Wang Jo-Yü (/), pp. 50-1; see also Kuhn (8), PP- 399-499. P- 372, fig. 1:9.

[e] Her letter of 30 July 1984.

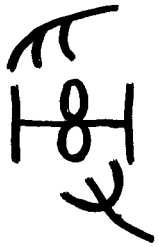


Fig. 216. Pictograph: silk-reeling with a reel-shaped device, Shang dynasty. Jung Keng (*3*), p. 507.

with drawing silk fibres from cocoons on to a silk-winding reel is meant, or alternatively some similarly connected action or even an official rank concerned with the production.[8.] Yet though silk-reeling can only be performed with a reel, there is neither definite textual nor pictorial proof for it prior to Chou or Sung times.

As previously discussed, many references to sericulture generally can be found in literature of the Ghou period, but as far as silk-reeling is concerned, we could only locate one absolutely convincing piece of evidence in the *Tso Chuan* (Master Tso's Tradition)[b] from the fourth year of Yin-kung[1] (— 719); there is no doubt that *chih ssu*[2] means 'reeling silk fibres'. *Chih ssu* is also the term used in the *Tshan Shu* and in the *Thien Kung Khai Wu*, many hundreds of years later.[0] In the *Shuo Wen Chieh Tzu* (Analytical Dictionary of Characters) of +121 the verb *sao*[3] is defined as 'to unwind cocoons to make silk threads' (t *chien wei ssujyeh*[4]),[d] T being defined as 'to reel silk fibres' *(chhou ssujeh*[5]*).*[e] '/' was understood in the *Lun Tit* (Conversations and Discourses)[f] as 'to unfold' or 'to draw', as was *'chhou'* in the *Tso Chuan.*[e] This meaning was derived in both cases from the reeling process. *'Sao'* is also known from the *Li Chi* (The Record of Rites) to mean reeling off silk fibres,[11] so textual evidence shows that this type of textile work was generally understood and widespread in Chou China.

This textual evidence is well supported by archaeological finds of silk textiles. The structure of the fabrics and the silk used leave no doubt that the silk was of a kind obtained by reeling techniques. What is more, silk fabrics excavated in Chiang-ling, Hupei province, serve as magnificent examples of the sericultural art and of weaving craftsmanship in the Warring States period. They excel not only through the variety of the weaving and their delicate quality, but also through

« Kuhn (8), p. 399: 'It is very likely that the origin of the complete pictograph of the character *ssu*[6] may have had to do with superintending a silk-workshop and that the pictograph which mirrors the work done in the silk-workshops was borrowed, and after a short time generally accepted, as an official title for all sorts of works executed in the interest of the ruling class and the community as a whole. Various ways of writing the pictograph *ssu* are recorded.'

t> Couvreur (i), p. 26.
* *SWCT*, ch. 13 *shang*, p. ia.
' Legge (a), vol. 1, p. 88, ' *Tzu Han'*, IX, 23.
e Fraser and Lockhart (1), no. 1074.
c *TKKW*, ch. *shang*, pp. 30b, 33a.
c *SWCT*, ch. 13 *shang*, p. ib.
» Legge (7), book XXI, p. 224.

[1] 隱公 [2] 治絲 [3] 繅 [4] 繹蠶爲絲也 [5] 抽絲也
[6] 嗣

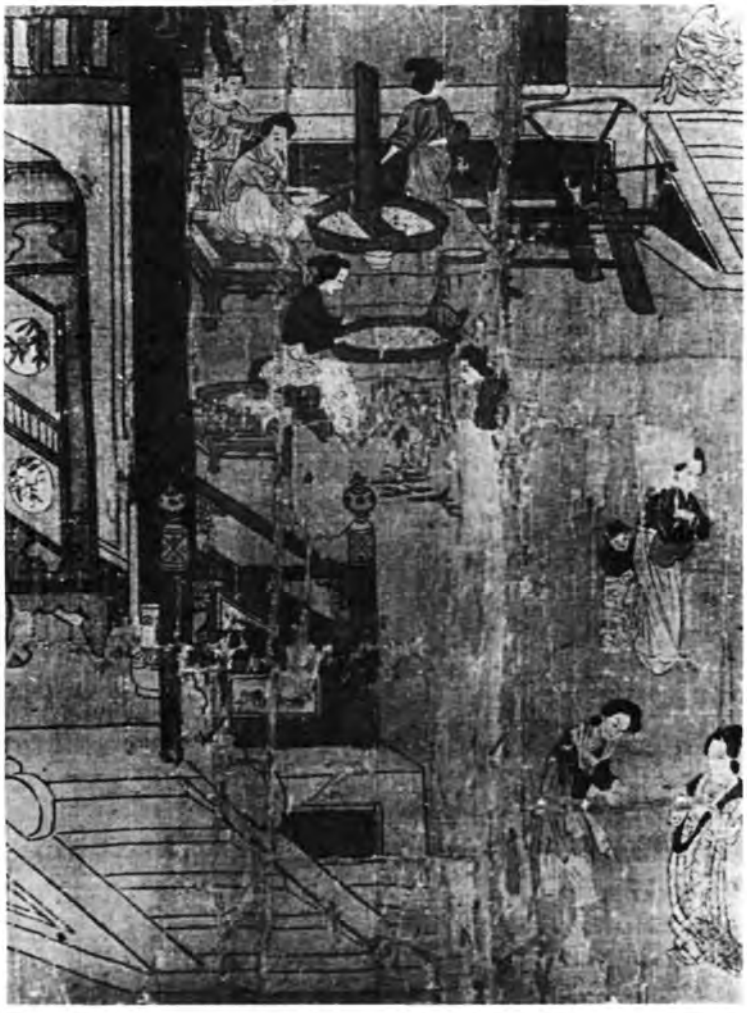


Fig. 217. Silk-reeling device on a handscroll traditionally attributed to Chhiu Ying 仇英 (died +1552), first half of the +16th century. The scroll is preserved in the Li-shih po-wu-kuan, Peking.

their artistic inventiveness of pattern and of style.[a] Indeed, from what we know of the silk producing regions of later times in the Far East, Near East and Europe, we can be certain that at least by Chou times, the Chinese were the only people in the world to have mastered not only silk-reeling, but also the whole silk-spinning technology with all its technical possibilities.

Before proceeding with a more detailed description of the working steps in silk-reeling, we should ask ourselves what we imagine a Shang and Chou silk-reeling device would be like. Clearly, it would have a water basin where the cocoons could be floated while reeling them off, and a silk-winder—a reel—on to which the silk

[a] Anon. *(683)*, pp. 1-8; Chhen Yüeh-Chün, Chang Hsü-Chhiu (/), pp. 9-11, colour plate.

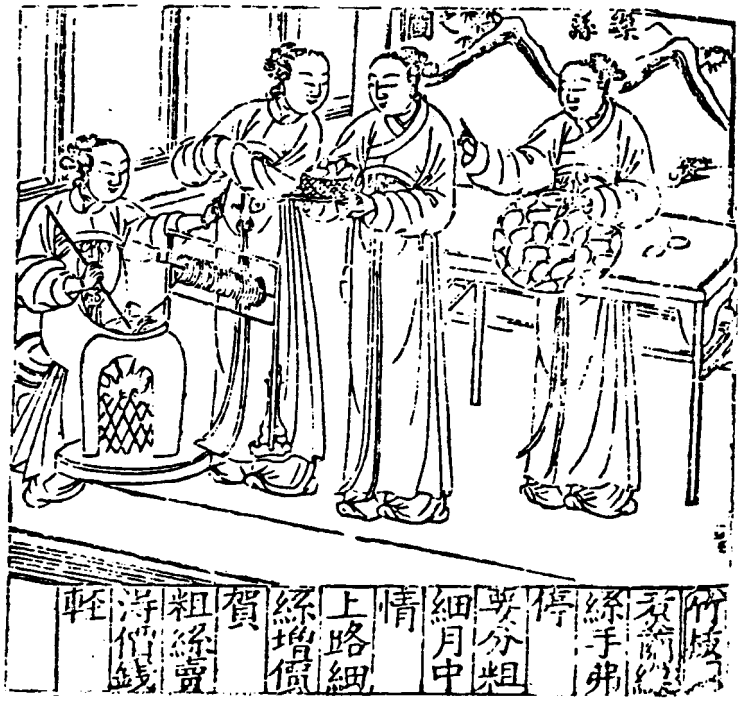


Fig. 218. Silk-reeling device, + 1607. *PYHHCY*, ch. 20, p. 14a.

threads were wound. We can then compare our ideas with the comparatively simple devices pictured on a handscroll ' Silk-workshops in the Quarters of the Palace Ladies[a]' by Chhiu Ying (died + 1552)[0] (Fig. 217) and in the *Pien Tung Hsüeh Hai Chhün Tu* (Seas of Knowledge and Mines of Jade Encyclopaedia for Convenient Use) of + 1607[e] (fig- 218). These are furnished with the essentials only—without labour- and time-saving equipment nor with any devices to improve the quality. The reeling equipment in the pictures merely consists of a water basin and a long tube of bobbin-shaped reel. The same sort of reeling device is pictured in the *Tösan Hiroku* ('Secret Record' of Sericulture) of + 1803, where we find depicted devices from the provinces Oshü, Tamba, Tango and Tajima.[d] (Fig. 219). Another illustration of Japanese silk-reeling is contained in the *Kogai Kinu Furui Taisei* (Complete Work on Sericultural Arts), published in + 1815 (Fig. 22o).[e]

It is not possible to state definitely that the Shang and Chou silk-reeling devices were like the types listed above; but there is some probability that they may have

" We have labelled this part of the untitled scroll. The scroll is preserved in the **Li-shih po-wu-kuan,** Peking, and traditionally attributed to Chhiu Ying although there is no obvious evidence for the attribution. Prof. Sung Po-Yin, Nanking, was so kind as to inform us about the existence of the scroll when we visited him in 1979. He handed tous a set of photographs. On the scroll, see Yang Tsung-Jung (j),pp. 24-5.

» *MB,* vol. 1, **pp.** 255-7. ° Kuhn (2), p. 364, ill. 26.

[d] *Tösan Hiroku,* ch. 2, pp. 124-5; appendix, pp. 225-7.

[e] *Kogai Kinu Furui Taisei,* ch. 3, pp. 134-5. The arts of silk production in Japan are also depicted in Lemp & Rieger (1).



Fig. 219. Illustration of silk-reeling in Ōshū (*Ōshū-ryū ito toru zu*), Japan, + 1803. *Yōsan Hiroku*, ch. 2, p. 125.

had a similar appearance in structure and function. The illustrations are almost self-explanatory; we can recognise several cocoons floating in a water basin on a stove, while the filaments from the cocoons are drawn off, combined by hand, and wound on to a small reel in front of the worker. Apart from the fire in the stove, which is not needed in the cold water reeling method, no simpler reeling device could have worked efficiently. The reeling-frame which most probably followed these simple types may have been a hand-operated cold or hot water reel. Here there were a structure of two posts with a crossbar at the top provided with a hook to guide the silk thread so as to have one hand free; this facilitated the reeling and improved the control of the silk thread. At first it may have been small, operated by one person only, but in the course of time it developed into a larger device, operated by two persons as is pictured in the + 1462 edition of the *Keng Chih Thu* and various other editions of the book (Fig. 22i).[a] It is also shown in the *Pien Min Thu Tsuan* of + 1593^ As we shall realise later, the development of a two-person silk-reeling device of this simple kind must have taken place long before

[a] Franke (n), pi. LXXXIII; the +1696 edition and all the Chhing editions, except the illustration in Pelliot (24), pi. L, are similar: see Franke (n), pi. LXXXIV; edition of + 1883, p. 13b.

» *PMTT*, ch. 1, p. 13a.



Fig. 220. Illustration of silk-reeling in Japan (*mayu o ito ni kuru zu*), +1815. *Kogai Kinu Furui Taisei*, ch. 3, p. 134.

Sung times and though more efficient silk-reeling frames appeared in the Northern Sung period, the old type never disappeared completely. The main reason for its survival was its simplicity, which meant it could be constructed at low cost, while all its individual parts could be used in other ways in the off-season. Hence it should not surprise us that the majority of Chinese silkworm breeders always looked for simple, cheap and effective devices for reeling. Only the well-to-do could afford highly mechanised silk-reeling frames.

Practical experience, based on local tradition and economic necessity, resulted in the development of different silk-reeling frames which can be put in several groups depending on their structure and function. However, all these advanced types performed the following tasks.[8,]

[B] See Kuhn (7), pp. 65-7.



Fig. 221. Silk-reeling, Chhing dynasty. *KCT* edition, Bibliothèque Nationale, Paris (Oe 89); reproduced from du Halde (2), pl. XIV.

i. Killing the moths in the cocoons. This was done either by plunging the cocoons into the hot water pan—the water temperature varied between 77 °C and 100 °G—or else by reeling them alive out of the cold water pan.[a] The latter was better for the quality of the silk, because the threads kept their natural appearance and resistance, but the hot water method was more often used because it allowed faster reeling.

2. For reeling, the cocoons were first of all stirred in the pan to loosen the ends of the fibres. The rough parts were cleared away, and then the fibre ends were taken up with chopsticks or a brush, or even with the fingers if necessary, and passed through the guiding-eye. Fibres from several cocoons were taken up together to form a single thread, the number depending on the quality of silk required. Fine silk consisted of three, normal silk of six or seven fibres, while heavy silk had eighteen or even more. The number differed from region to region and from period to period. In terms of quality defined in denier, the filaments would have corresponded to the qualities produced today. To be more precise, since denier defines the weight in grams of 9000 metres of a filament or

» *NSCY*, ch. 4, p. 14a.

yarn, the system is used as the standard count for all continuous-filament yarns such as silk and man-made fibres.[a] Five cocoons produce a denier 13, seven cocoons a denier 21, fourteen a denier 44 silk yarn. Based on the weight of silk skeins, three types can be distinguished, the *tuan-chi-ssu*[1] weighing 125 g, the *chhang-wen-ssu*[2] with 180 g, and the *thung-tzu-ssu*[3] with 500 g.[b] Although the sources lack any information about such a distinction, we may assume that a similar skein-weighing system was in use in pre-modern China.

3. The rounding and making-even necessary to get a perfect silk thread were to some extent achieved by the threads themselves during the reeling process. A further improvement was obtained by rotating the pan holding the cocoons as reeling proceeded, while the heat of the water also caused the cocoons to rotate in the pan, resulting in a slight twisting effect which helped to round off the silk threads. Furthermore, a method of self-crossing the threads was applied, a most ingenious technique which squeezed off the water during the process of evening and rounding.
4. On a sunny day with a breeze, drying was achieved through the motion of the eccentric lug, which oscillated the ramping-board so that it reeled the thread evenly from one side of the silk-reel to the other and back. If there was no breeze, a brazier with a small charcoal fire was placed near the silk-reel. This process was called 'drying out the water' *{chhu shui kan*[4]*).*[0]

Chinese texts distinguish between southern and northern silk-reeling devices. We cannot completely exclude the possibility that there were many differences between the two types of silk-reel which are still unknown to us. However, only the following have come to light. The cocoon assemblies—these are the cocoon groups floating on the surface of the water in the pan—numbered two in the north, but only one in the south. Again, in the north the ramping-board was placed on the front-posts of the frame, in the south there may have been no ramping-board at all or it may have been placed high above the pan. Nevertheless, these make it clear that the technology of the south certainly differed from that of the north. Moreover, in the + 1 ith century Chhin Kuan noticed that the methods used for silk-reeling in Shantung and in southern Kiangsu and northern Chekiang are not the same.[d] Lastly, from agricultural literature of the late Ming and Chhing dynasties, we know that northern technology was more successful over the centuries and that it was finally adopted by the southerners in the main centres of silk production.

As we have found out,[e] differences between the northern and southern types cannot serve as a basic distinction between the two groups because their general

» *TTD,* p. 53.
[b] We obtained this information at a visit to Wu-hsi-shih sao-ssu ti-erh-chhang[5], 24 September 1979.
[c] *TKKW,* ch. *shang,* p. 31a. [d] Kuhn (7), pp. 63-5.
[e] This will become clear in the subsection below.

[1] 短几絲 [2] 長紋絲 [3] 筒子絲 [4] 出水乾 [5] 无錫市繅絲第二廠

elements and their function are so similar. In consequence other criteria better suited to differentiating between these groups had to be devised. So we decided to classify the silk-reeling frames according to structural features, because these both reveal the development of the device and also emphasise the difference between well-to-do silkworm breeders and small breeders to whom it was only a seasonal business.

Primitive silk-reeling devices—as described above—had no roller-frame, the spinner having to draw and guide the silk thread on to the reel. One of the first improvements was the crossbar with a hook placed between pan and reel. It cannot be called a roller-frame, but it should be considered as a forerunner. By Sung times several types of roller-frame were already common and they have served as criteria for our classification.

i. The 'silk-reel frame with the roller-frame on the pan' *(kuo shangphai-fang[1])*. It is described in the *Tshan Shu* by Chhin Kuan, and mentioned in the *Thien Kung Khai Wu,* where it is called 'the Szechwan method of silk-reeling'.[a] To this category also belong the southern and northern silk-reeling frames and the 'silk-reel frame with the soundless roller' *(wu-sheng-chhe[2])*, illustrated in the *Tshan Sang Tshui Pien,*[h] where it is named 'reeling silk fibres from a hot water pan' *(jo-fu sao-huo-ssu[3])*[0] and 'reeling silk fibres from a cold water pan' *(leng-phen sao-shui-ssu*)*.[d] These examples come from the *Pin Feng Kuang I* of + 1742.[6]

2. The type that developed from the 'silk-reel with the roller-frame on the pan', and which appeared more recently in the history of the development of silk-reeling technology, is the 'complete silk-reeling frame' as pictured in the *Thien Kung Khai Wu* of +1637[1] and in the *Tshan Sang Chi Yao* of +1871.[8] Apart from the pan, all the other parts belonged to the working system of the frame itself; all functions were integrated, and no further equipment was necessary.

(i) *The Silk-reeling Frame with the Roller-frame on the Pan, from Northern Sung Times*

Chinese books have handed down to us information on various silk-reeling frames *(sao-chhe-chhuang[5])*,[h] sometimes with elaborate explanations, sometimes with descriptions barely sufficient to permit an identification. They have all one feature in common, however; they were manufactured and operated to facilitate and economise silk-reeling with a high standard of quality. This is expressed in the *Shih Nung Pi Tung* as follows:[1]

[a] *TKKW,* ch. *shang,* p. 31a.
[c] *TSTP,* ch. 11, p. 35a.
[''] *PFKI,* ch. 2, pp. 55a-56b.
[g] *TSCT,* ch. *thu-shuo,* p. ia; see also Tisdale (i), p. 14.
[b] *TSCT,* ch. *thu-shuo,* p. ia.
» *TSTP* by Wei Chieh of + 1899.
» *TSTP,* ch. 11, p. 34a.
['] *TKKW,* ch. *shang,* p. 33a.
« Quoted in JVSCT, ch. 4, p. 14a.

[1] 鍋上牌坊 [2] 無聲車 [3] 熱釜繅火絲 [4] 冷盆繅水絲 [5] 繅車床

The secret of reeling silk consists in getting the silk thread fine *(hsi[1])*, round *{yuan[1])*, even *(yiin[3])* and of proper tension *(chin[4])*, so that it is without contractions *(pien[5])*, remissness *(man[6])*, knots *(chieh[7])* and lumps *(ho[8])*.[3.]

The earliest extant source which describes the Northern Sung silk-reeling frame in detail is the *Tshan Shu* and its technical and historical importance cannot be overestimated. Indeed, the paragraphs of this work were cited, sometimes in a shortened version, in most of the sericultural treatises subsequently published in China.[b] However, before discussing the silk-reeling frame analysed in the *Tshan Shu,* a few remarks on the author and on the treatise itself may be of interest.[0]

Chhin Kuan[9], literary names Shao-Yu[10] and Thai-Hsu[11], whose family home was in Kao-yu[12], Yang-chou, Kiangsu province, was born in + 1049 i[n] Chiu-chiang[13], Kiangsi province. He was a quite well-known figure in his time, a poet and official, friend and disciple of Su Shih[14]. In +1085 he passed the *chin-shih* examination and subsequently held several posts as sub-prefectural registrar at Ting-hai, Chekiang province, and was instructor in a Confucian school at Tsai-chou, Honan province, as well as being a professor at the National University in the capital. He went through all the ups and downs of a typical scholar-official's life and career. He died on his way back from exile in Kuangtung province, tired and intoxicated with a smile on his lips so the Sung Annals tell us;[d] this was on the 17th of September + 1100, when he was 51 years old.[e]

The exact date of the *Tshan Shu* is unknown; a postscript dates its publication as + 1214, but to judge from the *curriculum vitae* of its author and collections of his works, Chhin Kuan composed it about + 1090 or earlier.'

The treatise is very short, only ten paragraphs, each consisting of only a few lines, adding up to no more than four pages in the *Tshung Shu Chi Chheng* edition.« More than half the text deals with silk-reeling machinery, while another paragraph describes the construction of wooden frames for rearing silkworms. It cannot be regarded as a complete treatise on sericulture in general, like the chapters on the subject in the *Nung Shu* and the *Nung Cheng Chhüan Shu,* but rather

[a] The commentary to the passage says that 'joining on the fibre of a new cocoon is a knot *(chieh thou wei chieh")*; occielli, loops are lumps *[ko-tan wei ho[16])* '.

[b] Parts of the text are cited for example in the following publications: *NS,* ch. 20, pp. 28a~2ga; *STTH, (chhi-yung),* ch. 9, pp. 24ab; *NCCS,* ch. 33, pp. igab.

[c] Kuhn (7), pp. 63-4. <* *Sung Shih,* ch. 444, pp. 13112-13.

[e] *SB,* vol. 1, pp. 235-41.

' The *Tshan Shu* has already been discussed from a bibliographical point of view by Franke (11), p. 49 and others, see Wang Yü-Hu (/), p. 80; see also *SBB,* pp. 239-40. In the Imperial Catalogue *Ssu Khu Chhüan Shu Tsung Mu Thi Tao, (nung-chia-lei[17])*, ch. 102, the treatise is attributed to Chhin Chan[18], the son of Chhin Kuan, but we should note—to correct this error—that the *Tshan Shu* is included in the *Huai Hai Chi[19]*, a collection of poetry, essays and official writings and letters, and also in the *Huai Hai Hou Chi,* both of which are definitely collections of parts of Chhin Kuan's works ; see *SBB,* pp. 403-4.

« *TSCC* edition, vol. 1471.

[1] 細 [2] 圓 [3] 勻 [4] 緊 [5] 褊
[6] 慢 [7] 節 [8] 核 [9] 秦觀 [10] 少游
[11] 太虛 [12] 高郵 [13] 九江 [14] 蘇軾 [15] 接頭爲節
[16] 疙疸爲核 [17] 農家類 [18] 秦湛 [19] 淮海集



Fig. 222. Silk-reeling frame, on a handscroll attributed to Liang Khai, first decade of the +13th century. By courtesy of the Oriental Department of the Cleveland Museum of Art, Cleveland, Ohio. (Purchase, John L. Severance Fund, no. 77.5, detail of section 3.)

as a technical treatise on sericultural equipment and machinery. But to judge from the precise descriptions, the author must have been familiar with silk-reeling and possibly owned such a reeling-frame from which he could take all the measurements given in his text.

From the short preface we may conclude that his wife Hsü Wen-Mei[1], whom he married in + 1067, had considerable influence on the realisation of the study. He tells us:[a]

When I was unemployed, I discussed the subject of sericulture with my wife, who is an expert in the rearing of silkworms, and then I wrote the *Tshan Shu.*

It is also interesting that he dealt only with silk-reeling as it was done in Yen-chou[2], that is, in the western parts of Shantung province, which he obviously preferred to the quite different silk-reeling methods of southern Kiangsu and northern Chekiang. He puts it as follows:[b]

(The method) I have written down today is not the same as that used by the silkworm breeders in Wu, but is entirely obtained from the people of Yen.

It would not be far-fetched to assume that his wife had received training in the

[a] *TS p.* 1. [b] *Ibid.*

[1] 徐文美 [2] 兗州

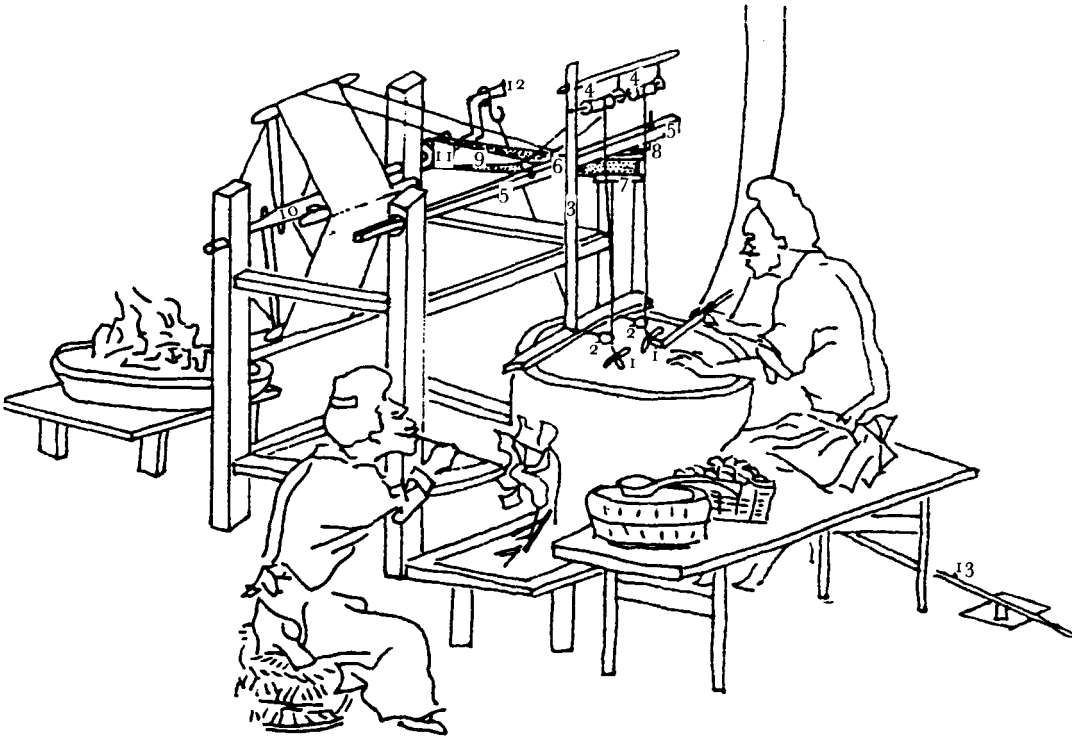


Fig. 223. Reconstruction of the silk-reeling frame of Sung times. 1, Cocoon assemblies. 2, Guiding-eyes. 3, Roller-frame. 4, Rollers. 5, Ramping-board. 6, Hooks. 7, Pulley. 8, Eccentric lug. 9, Driving-belt. 10, Axle of the silk-reel. 11, Crank-case. 12, Crank. 13, Treadle.

Shantung method when she was a girl and that he received practical instruction in the device from her.

The *Tshan Shu* does not contain an illustration of the silk-reeling frame described, but fortunately the Cleveland Museum of Art preserves a handscroll, traditionally attributed to Liang Khai ', and dated as being from the first decade of the + 13th century.[8.] On this a silk-reeling frame is depicted (Fig. 222), and it is the earliest picture of such a 'machine' in the world; it matches Chhin Kuan's description in many details. Of Liang Khai himself we know almost nothing. He was from Shantung province and served as a *tai-chao*[1] or painter in attendance at the Painting Academy of Hangchou, from about + 1201 to + 1204. He then left this institution and devoted himself to Chhan Buddhism.[b] We may assume that he painted the scroll during his time in the Southern Sung capital Hangchou, most probably to an official order for an educational picture, before he retired from public life. As the text of *Eight Dynasties of Chinese Painting* comments, ' It should

[a] The handscroll is preserved in the Cleveland Museum of Art, Cleveland, Ohio. Purchase, John L. Severance Fund; it is pictured in Anon. (604), pp. 78-80; see also Kuhn (7), p. 72, fig. 5.

[b] Osvald Siren (10), vol. 2, pp. 65-6; Laing (1), p. 76; Cahill (1), p. 129.

[1] 梁楷 [2] 待詔

be pointed out that agriculture and sericulture had been a subject reserved almost exclusively for the court painters. Depictions of the life and hardships of the peasants, as well as similar themes derived from the *Shih Ching* (Book of Odes) or other Confucian classics served as pictorial reminders for the ruling princes so they would not neglect the two great foundations of the empire.'[8.]

To judge from the picture, the painter must have known this type of machine very well; but obviously he did not understand the complete mechanism, otherwise he would have placed the pulley on top of the other front-post of the frame, where it could have been driven by the belt which moved the silk-reel. Indeed, that driving-belt is lacking in the picture. To make the entire construction more comprehensible, we have tried to correct and complete a +i3th century silk-reeling frame by making a drawing based on the text by Chhin Kuan (Fig. 223)-

We now give a translation of the text and, for a better understanding, have added a few notes from other Chinese sources:"

Hua-chih[1] (reeling)

Usually the water in the pan *{ting*[2]*)* for the cocoons has to boil. The hot water is bubbling (when silk-reeling begins). One must take chopsticks for (holding) the ends of the fibres *(hsii*[3]*)* to which they adhere before drawing them up. (That is why) it is called 'feeding' *(wei-thou*).* Do not take more than three fibres. If you take more, then the thread will be coarse, the quality inferior and thus fragile. One must bear this in mind while raising (the fibres). All individual fibres are drawn from (the cocoons swimming on the surface) of the pan through the guiding-eyes *(chhien-yens),* and then led upwards to the rollers *(hsing*[b] or *so-hsingi).* The rollers correspond in their motion to the silk-reel *(chhe*).* The threads then pass (from the rollers) to the ramping-board *(thien-thi*[9]*)* and thence to the reel.

As we shall see, this reeling-frame had two cocoon assemblies—*ssu-wo*[10] or *hsii-phan*[11]—each of them having three cocoons in the pan at the same time. This is an indication too that the silk-reeling technology here described is of northern origin, because in the Chinese texts,[0] a distinction is made in labelling illustrations of the southern and the northern silk-reeling devices. The pan of the northern silk-reel had two assemblies, the southern only one.

In our case, the two silk threads were produced parallel to each other. Most probably silk-reeling devices using more than two cocoon assemblies also existed in Sung times, but we have found no pictures or descriptions giving evidence of them.

» Anon. (604), pp. 79-80.

[b] The text translated is contained in the *TSCC* edition of the *TS,* pp. 2-3; see Kuhn (7), pp. 70-7. Franke (11), pp. 172-4 discussed the text but arrived at the conclusion that he could not explain it (p. 174): 'To me the description itself is incomprehensible.'

[c] *NS,* ch. 20, pp. 26a-2ga; *STTH, (chhi-yung),* ch. 9, pp. 23ab; *NCCS,* ch. 33, pp. I7a-i9b; *SSTK,* ch. 75, pp. 4b-6b.

[1] 化治 [2] 鼎 [3] 緒 [4] 餵頭 [5] 錢眼 [6] 星
[7] 鎖星 [8] 車 [9] 添梯 [10] 絲窩 [11] 絮盤

When the labourer is sitting in front of the reeling-frame to wind off the fibres the height of the pan should be about the same as the frame.[a] Most of the illustrations bear this out. The hot water pan was called *fu'* or *ting*[2]; the cold water pan where the water was not cold but tepid, was named *phen*[3] and the smaller pans *cheng* or *tseng**.[h] A general name for them was *kuo*[5]. They could be made of three materials:[0] copper, which was regarded as the best, a coarse quality of earthenware *(sha-kuo*[6]*)* or iron, which was considered to make a pan of poor quality. A large pan for several cocoon assemblies had a diameter of about 80 cm, that of a small one was some 30 cm. It was plastered all around the outside with adhesive clay *{chhang-chan-ni*[T]*)*[X] which formed a thinner layer towards the opening. After this it was dried in the sun. The name of such prepared pans was double pan *(chhuan-phen*[8]*).*

The stove or furnace *(tsao*[9]*)*[e] was built from unburnt bricks *(chuan-phi*[10]*)* with a stand *{thai*[11]*)* in its centre on which the pan was placed right in the middle of the furnace. This stand was evidently necessary to prevent the fire from directly heating the water in the pan and made it possible to keep the water at a constant temperature. The smoke passed away through a horizontal chimney or smoke-pipe *(tku^jyen-tung^^jyen-chhuang*[14]*^* or *wo-thu*[lsi]*)* which was placed near the top of the furnace opposite the opening of the fireplace *(yen-huo'*[16]*).*[1] This horizontal smoke-pipe arrangement is described and can be seen in the *Pin Feng Kuang*;'/.* An upright smoke-pipe is pictured in the *Tshan Sang Chi Too*[1] (Fig. 237) and described in the *Tshan Sang Tshui Pien*™ Peat or extremely dry wood served as fuel."

As we know from the *Shih Nung Pi Tung*[0] and from the pictures in the *Pin Feng Kuang*[l][p] (Fig. 231), a smaller auxiliary furnace *(lei'*[7]*)* was employed for the task of picking up the ends of the silk fibres *(ta ssu-thou*[1]**).* The cocoons were put into the water and made to rotate evenly with help of a skewer or chopsticks *(chu*[19]*).* This motion was necessary to soften the sericin so that the fibres would not stick together during reeling; it has nothing to do with dissolving the sericin, or degumming. The coarse ends of the silk fibres *(nang-thou*[20]*)* were then picked up, held near the surface, and jerked several times in order to fine down the coarse ends and waste less silk during reeling. Thereafter the fibres were cleared by pressing

» *NCCS,* ch. 31, p. 34b; *PFKI,* ch. 2, p. 51a.
[11] *NCCS,* ch. 31, p. 32b.
« *NCCS,* ch. 31, p. 36a; *PFKI,* ch. 2, p. 50b.
« *NCCS,* ch. 31, p. 33b.
[e] *SNPT* in the *NCCS,* ch. 31, p. 33b; TSCT, ch. *thu-shuo,* p. 6a. *TSTP,* ch. 4, p. 7a.
[1] *SNPT* in the *NCCS,* ch. 31, p. 34a.
* *TSTP,* ch. 4, p. 7a.
» *TSCT,* ch. *thu-shuo,* p. 6a.
' *SNPT* in the *NCCS,* ch. 31, p. 34a.
J *Ibid.*
[k] *PFKI,* ch. 2, pp. 54b-s6b.
1 *TSCT,* ch. *thu-shuo,* p. 5b.
[m] *TSTP,* ch. 4, pp. 7ab.
" *SNPT* in the *NCCS,* ch. 31, p. 34b; *TSTP,* ch. 4, p. 7a.
[0] *SNPT* in the *NCCS,* ch. 31, p. 34a.
» *PFKI,* ch. 2, pp. 54b-55a.

[1] 釜	[2] 鼎	[3] 盆	[4] 甑	[5] 鍋
[6] 砂鍋	[7] 長粘泥	[8] 串盆	[9] 竈	[10] 磚坯
[11] 臺	[12] 突	[13] 煙洞	[14] 煙囪	[15] 臥突
[16] 撙火	[17] 壘	[18] 打絲頭	[19] 筋	[20] 囊頭

the cocoons into the hot water with a perforated ladle *(lou-shao[1])*. Finally, the ends were suspended from the 'old silk pin' *(ssu-lao-weng[2])* which was attached either to the rim of the pan or to the floor. According to the *Shih Nung Pi Yung** fifteen silk threads were a regular number to be held by this pin, though in the case of coarse quality silk, the number of threads was reduced. This preparatory work facilitated and accelerated the actual reeling process.

Chhien-yen[3] (guiding-eye)

The guiding-eyes are fixed in a board which lies diagonally on the pan. It is about 9 cm broad and 9 *shu* thick." In the middle, at its thickest part, two copper cash (guiding-eyes) are inserted.[0] The board is wedged through the upright handles of the pan, and weighted down with stones. The ends of the fibres are combined (into one thread) by the guiding-eyes and led upwards. (That is why) (each) is called guiding-eye.

There were various names in use for the guiding-eyes such as *chhien-yen, tso-ssu-yen*,[d] chu-chen-yen*[5],[e] and *ssu-wo[6].[1]* Mostly the board was not wedged through the handles, but stones were used to weigh it down. The stones were essential to the stability of the wooden structure, and only when they were heavy enough to make the board immovable, could a regular motion of and even tension in the fibres be guaranteed as they were reeled off.

So-hsing[7] (roller)

The rollers are made of two[g] hollow tubes *(lu-kuan[s])* of bamboo each some 12 cm long. For spindles *(shu[9])* one takes round wooden (pieces). (Two) pieces of bamboo project upwards beside the handles of the pan, fixing the spindles in (the middle of) the bamboo rods. The motion of the rollers follows the silk-reel. Just below (the rollers) are the guiding-eyes. (That is why) it is called roller.

In the text of the *Tshan Shu* three rollers are mentioned, and these were most common in later times in Chekiang province. We have taken two because all illustrations show only this number. The roller has no motion of its own but is driven by the tension and pressure of the fibres passing on to the silk-reel. This is why the author speaks of a motion which follows that of the silk-reel. The *Nung Sang Chih Shuo*[h] reports that the bamboo tube rollers were very fine and that iron-spindles perforated them. The rollers could also be made of iron, and several other names apart from *so-hsing* were quite common for them; e.g. *hsiang-hsii[10],[l]*

» *SXPT* in the *MCCS*, ch. 31, p. 35a.

[b] The measurements are not important because they also depend on the size of the pan, for which no dimensions are given.

[c] The original text mentions only one copper cash but that information is wrong, because there are **three** rollers mentioned below. Two guiding-eyes and two rollers seem to be reasonable.

[d] *TSCT*, ch. *thu-shuo*, p. 2b.

[e] *TKKW*, ch. *shang*, **p.** 30b.

' *TSTP*, ch. 4, p. 8b.

s See above, n.[c]

» *MS*, ch. 20, p. 28a; *MCCS*, ch. 33, p. 19a.

' *TSCT*, ch. *thu-shuo*, pp. 20-33.

[1] 漏杓 [2] 絲老翁 [3] 錢眼 [4] 做絲眼 [5] 竹針眼
[6] 絲窩 [7] 鎖星 [8] 蘆管 [9] 樞 [10] 響緒

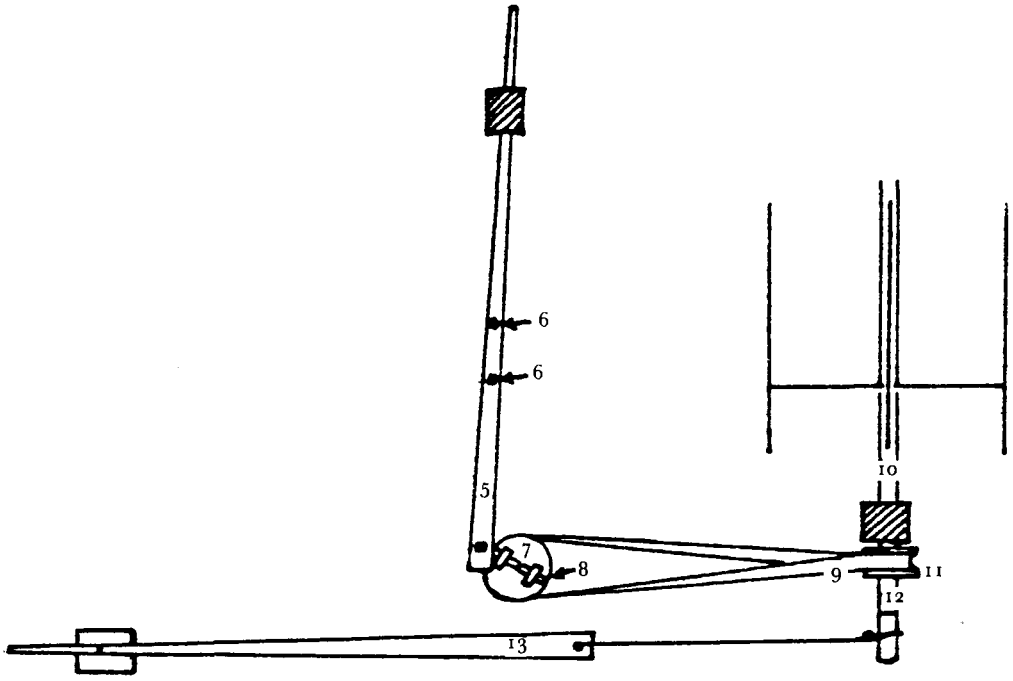


Fig. 224. The functional parts of the Sung silk-reeling frame. (For numbers see Fig. 223.)

sao-hsing[1] [a] or just *hsing*[2],* *jao-hsing*[3],° *chiian-tzu*\[d] *chu-tkung*[s,e] **or *fu*[6].* The spindle** which perforated it was made of bamboo, wood, and also of copper and iron as mentioned above.[8]

Thien-thi[1] (ramping-board) [Fig. 224]

The left extremity of the ramping-board is placed in a ring (made of) rope. (The ring) measures about 15 cm (in circumference). On the left post of the frame *(chhe-chhuang*)* a pivot *(ping*[9]*)* some 4.5 cm long is fixed (and) around it the pulley *(ku*[10]*)* rotates. (The pulley) is marked with a groove for the driving-belt *(huan-sheng*[11]*)*, which moves as the silk-reel does; (the axle of) the reel turns the driving-belt without interruption, and so the pulley revolves too.

On the pulley is an eccentric lug *(yii*[12]*)*, half of which projects over the pulley, (and) exactly in the centre an upright pin of about 4.5 cm in length is placed [Fig. 225] ; upon this the ramping-board is fitted. The ramping-board is a flat bamboo stick some 75 cm long on which are fixed hooks *(kou*[13]*)* of bent bamboo to guide the silk threads. The hole

» *TSTP*, ch. 4, p. 8b.
° *TKKW*, ch. *shang*, p. 30b.
[e] *Ibid.; MCCS*, ch. 31, p. 35a.
« *STTH, (chhi-yung)*, ch. 9, p. 23b; *SMPT* in the *MCCS*, ch. 31, p. 35a.
« *SNPY* in the *NCCS*, ch. 31, p. 34b; *TSCr*, ch. *thu-shuo*, p. 3a; *TSTP*, ch. 4, p. 8b.
t> *TKKW*, ch. *shang*, p. 33a.
[a] *MS*, ch. 20, p. 28a.

[1] 繅星 [2] 星 [3] 繞星 [4] 捲子 [5] 竹筒
[6] 筩 [7] 添梯 [8] 車床 [9] 柄 [10] 鼓
[11] 環繩 [12] 魚 [13] 鉤

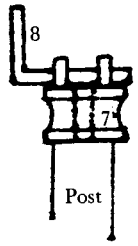


Fig. 225. The pulley and the eccentric lug of the Sung silk-reeling frame. (For numbers see Fig. 223.)

in the right extremity (of the ramping-board) is fixed to the pin (of the eccentric lug) which is parallel to two projecting ears on the pulley. The eccentric lug is inserted into these ears, and then the ramping-board is fitted on to the lug. (As soon as) the silk-reel is put in motion it draws the driving-belt, the driving-belt moves the pulley, turns the eccentric lug, while the eccentric lug oscillates the ramping-board, and so the silk threads do not come out flat *(phien[1])* (but round).

The ramping-board was also named *ssu-chheng[1,0,]* *sung-ssu-kan[3b]* or *hsing-ma*[*,c]* or it was labelled with the more popular name 'pull-up lance' *chhou-chhiang[s.d]* The two guiding-hooks—their number depended on the number of rollers or on the number of cocoon assemblies in the pan—were originally made of bent bamboo, later also of copper and iron and shaped like a corkscrew. Other terms for them were *sung-ssu-kou[6,e]* *sung-ssu-kan-kou[7]* *,[f]* and *hsing-tao-chih[8.e]*

The eccentric lug, also named *shuan[9h]* or *heng-liang[10]*,* was fastened in the upright ears of the pulley also called *mu-niang-teng[11]*,* or instead of *teng* the character to[12k] was also possible. The pulley was mostly round but 8- or io-sided polygonal pulleys are reported as well.[1] They were flat on their bottom and top, with concave-shaped sides and were made of mulberry wood.[m]

Chhe™ (silk-reel)

The silk-reel is like a wooden spindle (or winch) *(lu-lu[1]*).* Two of its spokes must be movable for convenience in taking off the silk (skeins).

The four-sided winch or reel was normally preferred to the six-sided. It was easier for reeling because it was smaller and simpler to control, as well as to turn or stop, and to change." The four-sided reel was equipped with both immovable fixed

» *TSTP*, ch. 4, p. ioa.
[c] *STTH, [chhi-yung)*, ch. 9, p. 23b.
[e] *TSTP*, ch. 4, p. ioa.
8 *STTH, (chhi-yung)*, ch. 9, p. 23b.
1 *TSTP*, ch. 4, p. 11a.
" *TSTP*, ch. 4, p. 10b.
[m] *Ibid.*
» *TKKW*, ch. *shang*, p. 30b.
[a] *TSTP*, ch. 4, p. ioa.
' *TKKW*, ch. *shang*, p. 30b.
* *TSTP*, ch. 4, p. 11a.
i *TSCr*, ch. *thu-shuo*, p. 2a.
' *Ibid.*
n *NS*, ch. 20, p. 28b; *NCCS*, ch. 9, p. 23b; *TSTP*, ch. 4, p. 12b.

[1] 偏 [2] 絲稱 [3] 送絲干 [4] 行馬 [5] 抽鎗
[6] 送絲鉤 [7] 送絲干鉤 [8] 行道枝 [9] 閂 [10] 橫梁
[11] 牡孃鐙 [12] 墩 [13] 車 [14] 轆轤



Fig. 226. The southern silk-reeling frame (*nan-sao-chhe*), + 1313. *NS* (+ 1530 ed.), ch. 22, pp. 26ab.

spokes *(fu*[l]*)*,[a] *(cMao*[z]*)*,[h] and movable ones. The four rails were attached to their tops. As the *Tshan Sang Tshui Pien* reports in the paragraph 'Inserting the Spokes' *(kuan chiao*[3]*)*,[c] a horizontal groove was chiselled out in the axle *(khuang-ckou*)*[a] in which to place the spokes, and a wedge *(tking-mu*[s]*)*[e] was knocked into the intermediate space to fix them. The wedge penetrated through the axle. If one hit the broad end, the spokes were set in very tight; if one hit the sharp end, the spokes could be taken off. This sort of fitting is pictured in the *Thien Kung Khai Wu*[l] (Fig. 236). Elm or *Sophora japonica* wood was used to make them.[8]

Without a doubt, the silk-reel was already operated by a treadle-mechanism at the time of the Sung dynasty, though different types may have been in use.[h]

» *TSTP*, ch. 4, p. 12b.
[b] *TSCT*, ch. *thu-shuo*, p. 2a. « *TSTP*, ch. 4, pp. I2b-i3a.
[d] *NS*, ch. 20, p. 28b; *STTH, {chhi-yung)*, ch. 9, p. 23b; *NCCS*, ch. 31, p. 34b.
[e] *TSTP*, ch. 4, p. 13a. ' *TKKW*, ch. *shang*, p. 33a.
[g] *SNPT in* the *NCCS*, ch. 31, p. 34b; *MS*, ch. 20, p. 28b.
[11] Several Chinese articles supply some information on the treadle-mechanism of Chinese spindle-wheels: Li Chhung-Chou (5), pp. 73-5; Chao Chheng-Tse *(1)*, pp. 28-32.

[1] 輻 [2] 腳 [3] 貫腳 [4] 軠軸 [5] 杠木

Although the *Tshan Shu* does not mention the treadle, the + 13th century hand-scroll (Fig. 222) and the illustrations in the *Nung Shu* (Figs. 226, 227) depict it clearly. Furthermore, the highly mechanised silk-reeling frame of the *Tshan Shu* would only have made sense with a treadle, otherwise an additional worker would have been needed.

We find the earliest reference to the treadle-mechanism and its importance in the reeling process in the *Shih Nung Pi Tung* (The Farmer's Essentials) of Sung times. This text explains how to maintain the fine diameter of the reeled silk thread when new cocoons had to be added into the cocoon assembly. The text says :[a]

When replacing (new cocoons for ones already reeled off) their number should not exceed three or four (at one time). If one neglects to replace them, then the thread gets thin; if one replaces (too) many, then the thread gets thick. If by chance the replacing by hand does not work alternately (that means it happens too slowly), then the treadle slows down (the rotation of the) reel which results in a comparatively thick silk thread. If by chance (the cocoons) replaced by hand are many, then the foot-operated treadle *(tha[1])* rotates the reel more swiftly which results in a comparatively thin silk thread. Only if hand and foot correspond to each other (in their actions), can one obtain (silk of) even quality.

The names for the treadles were: *tha-chiao-pan[z],[b] tha-nieh[3],[c]* and *hsieh-pan**.[ü] Generally the treadle-base *(ti-pan[s])[e]* was dovetailed into the front post of the construction frame at that side where the crank of the silk-reel projected. The crank was connected with the treadle by means of a horizontal transmission **rod** *(heng-thiao[6])* which at one end was fixed to the crank, with the other end joined to a vertical transmission rod *(chih-thiao[7])*, which was operated by the treadle.[1]

At one end of the axle of the silk-reel a round pivot was placed, the length of which extended beyond the post of the silk-reel frame, and to this was fixed the round or eight-sided crank-case *(leng[s])*. In this crank-case the treadle-operated wooden crank *{chou-ping[9] ,[g]ping[10]^ niao-tiao'[1],[1] tiao-chih[12]})* was inserted, and the driving-belt also ran around it, thus transmitting the motion to the axle of the reel and to the pulley of the ramping-board.

(a) The Southern and Northern Silk-reeling Frames.

Having now discussed the earliest detailed source still extant, the *Tshan Shu* of *c.* + 1090, we should turn to the various editions of Wang Chen's *Nung Shu* published after + 1313 to find out in which way he treated the subject and what information

• *SNPT* in the *NSCT,* ch. 4, p. 15a; *NCCS,* ch. 31, p. 35b.
[b] *TSCT,* ch. *thu-shuo,* p. 5a.
[d] *TSTP,* ch. 4, p. 13b.
' *Ibid.,* pp. I3a-i4a.
[h] *TSCT,* ch. *thu-shuo,* p. 2a.
[1] *STTH, (chhi-yung),* ch. 9, p. 23b.
0 *STTH, (chhi-yung),* ch. 9, p. 23b.
e *Ibid.,* pp. i3ab.
8 *Ibid.,* p. 12a.
> *NS,* ch. 20, p. 28b; *NCCS,* ch. 33, p. 19b.

[1] 踏 [2] 踏脚板 [3] 踏躡 [4] 鞋板 [5] 底板 [6] 橫條
[7] 直條 [8] 棱 [9] 軸柄 [10] 柄 [11] 裊掉 [12] 掉枝

he adds to our knowledge of Sung reeling-frames. In all, he describes four silk-reeling frames in his treatise : the southern silk-reeling frame (Fig. 226), the northern silk-reeling frame (Fig. 227), the hot water pan and the cold water pan.

Before asking several questions about the text and the illustrations, and about silk-reeling traditions in general, we should first look at the descriptions of the southern and northern silk-reeling frames as they are contained in the *JVung Shu:*[a]

The silk-reeling frame *(sao-chhe*[1]*).*

When reeling silk the fibres are drawn up from the surface of the pan, filled with water, they pass through the guiding-eye *(kuan Mien-yen*[2]*),* and ascend to the roller.[b] The rollers correspond in their motion to the silk-reel. (The threads) then pass (from the rollers) to the ramping-board and thence to the reel *(khuang*[3]*)? Khuang* is the wheel for silk-reeling. Then the reeling of silk on the reel is perfected.

After this Wang Chen quotes from the *Tshan Shu.*[A] To explain the rollers he has added a short commentary from the *JVung Sang Chih Shuo:*

The bamboo tubes (rollers) should be fine; iron spindles *(thieh-thiao-tzu*)* perforating them (so as to act as axles for the tubes). The two rollers *(chüan-tzu*[s]*),* also made of iron are quite useful.[e]

After this short explanation, the text continues with the paragraph 'Ramping-board' from the *Tshan Shu.* Wang Chen comments on it:

I venture to say (something) about the text above : the reel *(chhe)* nowadays is called *khuang.* It needs a framework *(chhuang*[6]*)* on which to rest.

Thereafter he continues quoting the *JVung Sang Chih Shuo,* thus providing further information on the structure of the reel:'

The *JVung Sang Chih Shuo* says : The pan *(ting)* is placed some thirty cm below the frame of the reel. The reel has a length of about 60 cm, its diameter in the middle is nearly 12 cm, and at the ends of both sides about 6 cm. Elm *(jii*[7]*)* and *Sophora japonica (hua?)* are used to make the four- or six-sided reels. The length of the spokes is about 105 cm. The six-sided reel is not like the four-sided, because if the reel is small, then the silk can easily be taken off.

* *NS,* ch. 20, pp. 28ab, 29a; *JVS* (+1530), ch. 22, pp. 28ab, 29a; also quoted in the *STTH, (chhi-yung),* ch. 9, pp. 24ab; *NCCS,* ch. 33, pp. igab.

[b] The texts of the various editions differ here, but without change in the meaning.

[c] This sentence is quoted from the *TS* without giving the reference.

[a] Only the subtitle of the paragraph 'The Construction of the Silk-reeling Frame' *(sao-chhe chih chih")* does not come from the *TS.* Apart from a few characters which have been exchanged, eleven characters from the end of the paragraph 'guiding-eyes' are missing.

[e] *Chüan-tzu* must have been another name for roller. From the context this appears to be the only reasonable translation.

' A similar version of the text is quoted in the *NCCS* which gives as its source the *SNPT,* see *NCCS,* ch. 31, p. 34b.

[1] 繅車 [2] 貫錢眼 [3] 軠 [4] 鐵條子 [5] 捲子
[6] 床 [7] 榆 [8] 槐 [9] 繅車之制

After this explanation of the reel, Wang Chen continues his commentary:

(The frame) contains the axle of the reel *(hhuang-chou*[1]*).* This axle has a crank made of iron at one end; alternatively a piece of bent wood is used to revolve it. When the right foot operates the treadle, then the reel follows this motion and revolves, drawing the silk threads from below up on to the reel. The general term for this device is 'silk-reeling frame'.

Thus Wang Chen contributes details about the material of the roller, the reel and its spokes, and the treadle which was used to operate the entire frame. It is clear that his description must have been of a frame very similar in kind to one discussed by Chhin Kuan. But this is not surprising; Chhin Kuan dealt with a silk-reeling frame from western Shantung in north China, while Wang Chen was a native of Tung-phing,[2] also in western Shantung. Indeed, this may account for similarities in the contents of the descriptions and, to some extent, in the illustrations of silk-reeling in the *Nung Shu.* However, before we discuss the latter, it is worth adding a few remarks about Wang Chen's aims in describing no less than four types of frame in his book.

There is no doubt that Wang Chen looked on himself as a sort of encyclopaedist, and he certainly possessed all the education and knowledge necessary for him to live up to so exalted a title. For this reason alone he would have tried to include every advanced type of reeling-fame, and also have attempted a classification into southern and northern, and hot water and cold water types. But this is not all. From text and illustrations yet another of the author's unspoken intentions becomes clear; it was his desire to give some general education in the seri-cultural arts. This last was why his pictures of these advanced types of frame show them to be almost industrial in design (Fig. 227), so implying silk production on a large scale. This approach manifests itself in the comparatively elaborate execution of details, in the way the functional parts are all labelled, and finally in the number of workers—at least two of them operating each ' machine '. The importance of these frames will become completely evident when discussing the economy of silk-reeling.

Now we have reached the point where we should look at the woodcut-illustrations of these silk-reeling frames, concentrating on the + 1530 and + 1774 editions of Wang Chen's *Nung Shu.* In doing this we shall find that, unfortunately, not all the pictures display the artistic mastery in composition and execution of the frame as does the + 13th century handscroll attributed to Liang Khai.[a]

The illustrations of the frames in the + 1774 edition, which are based on the manuscript of the *Nung Shu* from the *Yung Lo Ta Tien* (Great Encyclopaedia of the Yung-lo Reign Period), are reduced to less than the indispensable essentials for understanding and illustrating the text which goes with them. How far the

[a] Compare Figs. 222 and 223.

[1] 軠軸 [2] 東平

+ i8th century execution of these woodcuts can be trusted, especially with respect to faithfulness in detail and minuteness in the reproduction of technical machinery, which was most probably incomprehensible to the artists, and how close the newly made illustrations came to the *Tung Lo Ta Tien* original, remain unanswerable questions, because the *Tung Lo Ta Tien* version of the *Nung Shu* is no longer available.[8.]

Due to their poor quality and the uncertainties in the history of the illustrations of the + 1774 edition,[b] we have decided to rely on those in the edition of + 1530;[0] they are more intelligible, and not only from a technical point of view, and are also more thoroughly executed.

There is still another point of some significance which stresses the importance of the + 1530 edition as a reliable picture source. As far as one can find out when comparing the illustrations of the *Nung Shu* and the *Nung Cheng Chhiian Shu* of + 1639, Hsii Kuang-Chhi, the author of the latter work, chose not only the illustrations of the chapters on silk from the + 1530 edition for reproduction in his own work, but seems also to have quoted from this edition.[4] And it was not only Hsii Kuang-Chhi who appreciated this edition and made use of it. Wang Chhi, compiler of the *San Tshai Thu Hui* (The Universal Encyclopaedia) of + 1609, incorporated these selfsame illustrations of sericulture in his encyclopaedia.[6] Moreover, it appears that the + 1530 edition was possibly the only one available, and that the + 1313 edition had already been lost.

In our context, this tradition can be seen very clearly from the illustration of the northern silk-reeling frame (Fig. 227),' which also merits further attention because it not only shows the frame but also provides us with the names of the various functional and structural parts, labelled according to the convention adopted in such technical illustrations of Chinese origin.[8] Regrettably, we have been unable to trace the source of this particular illustration. It must originally have belonged to another work or series of technological textile drawings, otherwise the number ' 26' (white characters on black background) would hardly make sense. Interestingly, the artists who manufactured the woodcuts for the *San Tshai Thu Hui* omitted this number in their reproduction.

But where could this illustration have come from? Judging from the terminology on the labels used, and especially from the term '*e-mei-chang*[1] ', which will be discussed below, there is some reason to date its origin earlier than the *Shih Nung Pi Tung* (The Farmer's Essentials) which, as we have seen, was written in the

[8] Originally the chapters 625-37.
[b] *NS*, ch. 20, pp. 26ab, 27ab.
[0] JVS (+1530), ch. 22, pp. 26ab, 27ab.
[a] This is obvious when comparing the text of the *MS* editions with the text of the *NCCS*.
[e] *STTH, {chhi-yung),* ch. 9.
['] *NS* (+1530), ch. 22, pp. 27ab; *STTH, (chhi-yung),* ch. 9, p. 23b.
[8] See for example, *TKKW* of + 1637.

[1] 蛾眉杖

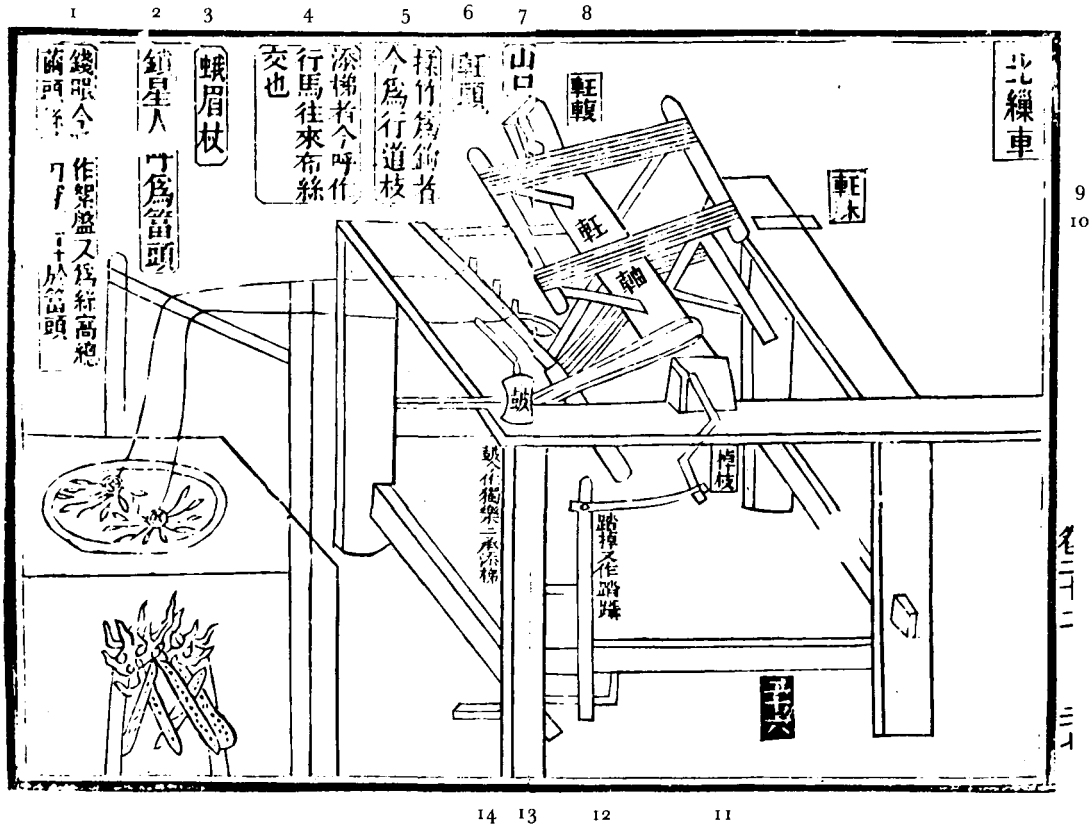


Fig. 227. The northern silk-reeling frame (*pei-sao-chhe*), + 1313. *NS* (+ 1530 ed.), ch. 22, pp. 27ab.

+ 12th or + 13th centuries by an unknown author from north China.[8,] The *Shih Nung Pi Tung* is a lost work, but fortunately parts of it are contained in the *Nung Sang Chi Tao* of + 1273 and other later agricultural works.[b] From the change in terminology" (Table 7) we may deduce the original illustration was drawn after about + 1090 and probably before about + 1270.

Let us see now what the labels state (Fig. 227). They are translated—at the top: left to right 1-8, in the middle at the right side 9-10, at the bottom from right to left n-i4:[d]

1. Today the guiding-eyes *(ckhien-jen)* float (on the surface of the water) in the stirring-pan *(hsti-phan)* which is also called cocoon assembly *(ssu-wo).* The fibres

[a] Wang Yü-Hu *(i),* p. 107.
» *NSCT,* ch. 4, pp. I3b-i5a.
[c] The old terms are very often from the *TS* as in the cases of *so-hsing, kou, ku, chhe, thien-thi.* The term *e-mei-chang* is crucial for the dating.
" *NS* (+ 1530), ch. 22, pp. 27ab; *STTH, (chhi-yung),* ch. 9, p. 23b.

drawn from the cocoons are collected, drawn through (the hole in the coin) up to the rollers.[a]

2. Today the rollers *(so-hsing)* are also called *fu-thou*[l,h].
3. 'Butterfly eyebrow staff' *(e-mei-chang*[2]*).*[c]
4. Now the ramping-board *(thien-thi)* is called *hsing-ma*[3]. (It) oscillates, back and forth, (so) arranging (in layers the silk threads of) the silk skeins *(ssu-chiao*[4]*).*
5. Bent bamboo is used as hooks, now called *hsing-tao-chih*[s].
6. The reel *(khuang-thou*[6]*).*
7. The opening in the bearing *(shan-khou*[1]*)* (which takes the axle of die reel).
8. The spokes of the reel *(khuang-fu*[s]*).*
9. The frame of the reel *(khuang-chhuang*[9]*).*
10. The axle of the reel *(khuang-chou*[10]*).*
11. The crank *(tiao-chih*[11]*).*
12. The transmission rods *(tha-tiao*[12]*)* combining the treadle with the crank (fastened to the) treadle *(tha-nieh*[13]*).*
13. The pulley *(ku*[1]**).*
14. Today the pulley *(ku)* which holds the ramping-board is called *tu-lo*[Is,d].

The fast spread of this advanced silk-reeling device becomes evident from the change in the terminology (Table 7) which occurred between the + 1 ith century and late Ming times (first half of the + 17th century).

Hot and Cold Water Basins

From the arrangement of the illustrations and textual paragraphs in the *Nung Shu* we get the impression that the hot and cold water basins are separate silk-reeling frames with typical features different from the already familiar devices from the south and north. But this impression is certainly wrong. The discussion of the hot and cold water basins and their reeling methods should be regarded as basic to both northern and southern silk-reeling frames, because one of the two basins had to be chosen for reeling in any case.

* The passage reads: *chhien-yen chinphing-tso hsii-phan,yu wei ssu-wo. tsung chien-thou ssuyü nei chhuan shang shengyüfu-thou">.The STTH*illustration does not have the character *chhien.The phing* is lacking in the JVS, because the wood-block from which the illustration is printed, was damaged. The *STTH* illustration does not have the character *chien.* From the character *ssu* to the character *sheng* we have consulted the *STTH* illustration.

» On the illustration, the character Jen follows after *so-hsing;* it made no sense to us, so we replaced it by the character *chin".*

[c] Will be discussed in *(g),* (5), (i).

[d] In the *NS* illustration we find the character *erh.* It does not appear in the *STTH* illustration. We did not understand the *erh*[li] in this context.

[1] 簫頭 [2] 蛾眉杖 [3] 行馬 [4] 絲交 [5] 行道枝
[6] 軠頭 [7] 山口 [8] 軠輻 [9] 軠牀 [10] 軠軸
[11] 掉枝 [12] 踏掉 [13] 踏躡 [14] 鼓 [15] 獨樂
[16] 錢眼今平作絮盤、又爲絲窩、總繭頭絲於內穿上昇於簫頭。 [17] 今 [18] 二

So it is not surprising that the text paragraphs mainly deal with the water basin, the pan and the way it should be made, the stove and the rollers, clearly aiming at differentiating between the quality of silk obtained by using the various basins. Here the author concentrated on the process of drawing-off the fibres from the cocoons in the basin, so the paragraphs on hot and cold water basins must be regarded as additional information on the subject and not as new types of frame.[a]

Wang Chen says:[b]

To reel silk a pan is needed. The types which are used by the farmers nowadays are deep and big. They take an earthenware basin *(phan-tseng[1])*[0] combined with a pan *(fu[1])* which can replace a *ting-pan (ting).*

He then explains the sentence by a quotation from the *Nung Sang Chih Shuo:*[d]

The pan *(fu)* should be large and is placed on the furnace *(tsao).* The furnace is just like that used in the steaming process. Coarse silk *(tshu-ssu[3]),* the thread with the single winding *(tan-chiao*),* is reeled but (the thread with) the double winding *(shuang-chiao*)* can also be done.[e] On (top of) the pan the earthenware (reeling-) basin (is placed) so as to join its mouth. One pours water into the basin filling it up to 8/10 (of its capacity). If in the middle of the basin a wooden board *(pan-Ian[6])* is used to divide (the basin into two sections)/ then two workers can attend to the reeling while sitting opposite each other. If the cocoons are few, a small basin may suffice.[8]

The water has to be constantly hot so as to revolve the cocoons properly when reeling them off. If there are many cocoons, then the silk-reeling cannot be performed (successfully) and (the cocoons) are destroyed by the boiling (water).[11] If there are many cocoons, it is advisable to use this furnace to yield (the expected results) quickly.[1]

The illustration going with the text depicts a hot water basin shaped like a bathtub. It also shows two workers in action sitting side by side and not, as described in the text, 'opposite each other'. From the context, it is quite clear that hot water reeling had to be chosen when many cocoons needed reeling in a short time. Even two persons reeling them off could still be positioned beside the large hot water basin.

[a] The illustrations do not need to be reproduced because they add nothing new. Their equipment lacks a real roller-frame and a ramping-board. They are operated by a treadle-mechanism. We cannot answer the question of whether these illustrations were originally intended to go with the paragraphs, because there are inconsistencies between illustrations and text, for example about the rollers.

[b] *NS,* ch. ao, p. 30a; *NS* (+1530), ch. 22, p. 30a.

[0] The *SNPT* text has *phen-tseng*'.*

[ä] A similar passage can be found in the *SNPT,* quoted in the *NSCT,* ch. 4, p. 14a.

[e] This sentence, which is an explanatory note to the text by the unknown authors of the *NSCS* and the *SNPT,* will be discussed below in detail.

[8] *Ibid.*

[h] This sentence differs in the *NSCS* and in the *SNPT* source.

[1] This sentence is not contained in the *SNPT.*

[1] 盤甑 [2] 釜 [3] 粗絲 [4] 單繅 [5] 雙繅
[6] 板欄 [7] 盆甑

Additional information is supplied by the *Shih Nung Pi Tung* in which a small pan is described:[a]

If the boiler *(fu)* is small, one uses a furnace with a smoke-pipe *(thu-tsao[1])*. The diameter can be about 30 cm or less. (If the boiler is) small and so (only) few cocoons are put (into the hot water), then these need to be pressed down (under the surface of the water) repeatedly. If many cocoons are put in, then they get boiled (and the quality of the thread) is uneven.

Further on in the text we find a short and incomplete description of the silk-reeling frame, from which we only translate the passages relevant here:[b]

The frame of the silk-reel and the pan are equally high. The axle is about 60 cm long, its diameter in the middle measures some 12 cm, at the ends of both sides about 9 cm... A treadle is required.

The bamboo rollers of the silk-reeling frame should be fine (and small) like the rollers for the production of thin tabby silks. Iron spindles perforate the rollers. The two posts (of the roller-frame) should be made of iron. The two vertical posts are horizontally penetrated at their tops by the iron spindle; the iron spindle runs through the rollers; when this is the case, then it is handy and advantageous (to operate). If it is not like this, then this excellent silk cannot be achieved. The ancients had a saying: 'The workman who wants to be good at his job must first make his implements to his best advantage. (Then) surplus is usually the rule.'

For the production of high quality silk a small pan was evidently preferred to a large one. The quality depended on the roller-frame, its firmness and the way the rollers were made.

We read in the *Nung Sang Chih Shuo* about the pan of the cold water basin and the silk obtained from it by reeling:[c]

From the cold water pan one can reel fine silk (where the threads have) a complete winding *{chhiian-chiao[2])*; from cocoons of middle quality one can reel (thread with) a double winding *(shuang-chiao[3])*. The quality of the silk reeled off" from cold water is fine and soft but tough compared with silk from hot water.

Although (this pan) is called a cold water pan, (the water actually) is warm.

The pan is large and its outside has to be plastered first with mud. The diameter of its aperture measures more than 75 cm. The pan needs preparation beforehand: it is turned over, and the bottom plastered with adhesive clay in four layers. Underneath*[1] the clay is four fingers thick, getting gradually thinner towards the aperture. It is dried in the sun, and its name is double pan[4] *(chhuan-phen)*. When it is used, one pours water into it filling

[a] *SNPT* quoted in the *JVSCT*, ch. 4, pp. 14a-15a; *NCCS*, ch. 31, pp. 33b.

[b] Parts of the description we have already found in the *MS* text. There the source is named *NSCS*. The text translated here is from the *NSCT*, ch. 4, p. 14b; *NCCS*, ch. 31, pp. 34ab.

[c] The text is from the *NSCS*, quoted in the *NS*, ch. 20, p. 31a, and from the *SNPT*, quoted in the *NSCT*, ch. 4, p. 14a. Only a very short passage of the text to the illustration is quoted in the *NCCS*, ch. 33, p. 31b.

<• The two characters at the beginning of the sentence in the original text make no sense to us *(chih chhun ni hou ssu chih chiang chih chhun chien po[5])*. We have, therefore, interpreted the text in a technically sensitive way.

[1] 突竈 [2] 全繳 [3] 雙繳 [4] 串盆

[5] 至唇泥厚四指將至唇渟薄

it up to eight or nine tenths (of its capacity). The water should be warm and of constantly equal (temperature) without becoming now cold (or) now hot.[a]

Here we learn that the system of the rollers—quite apart from the quality of the cocoons—defined the quality of the silk thread. And the functional quality of these rollers depended on where the roller-frame was placed, on the material of which it was made, and on the number, type and size of the rollers themselves. In view of this, we next turn to the various roller-systems used in Sung China.

(ß) Roller-systems : The Butterfly Eyebrow Roller

As we have already seen rollers described above were made of hollow bamboo tubes through which the spindles passed as a sort of axle. These spindles fitted into two bamboo or iron posts fixed to a board placed on the rim of the pan, and stretching across the water surface. The board was weighted down by stones or wedged between both upright handles of the pan. The rollers were necessary both for the transport of the threads and in the evening and rounding process. To form and guide the threads the rollers often had grooves cut into them.

After examining the illustration of the silk-reeling frame pictured in the *Thien Kung Khai Wu,* where the threads do not pass directly from the rollers to the hooks of the ramping-board, but seem to return to their point of origin near the guiding-eyes, we first began to doubt whether the usual explanation of their function would suffice in this case (Fig. 236). The illustration in the *Tshan Sang Chi Tao* of +1871 (Fig. 237)—which differs in many small but nonetheless important details from the pictures in the *Thien Kung Khai Wu* and in the *Tshan Sang Ho Pien* (The Complete Compilation on Sericulture) of + 1843^—shows an exciting 'innovation'. This is the self-crossing of the threads, which occurs before they pass on to the hooks of the ramping-board. Such crossover method is a perfect way of squeezing the water off the threads during evening and rounding. The earliest description of this—a document of outstanding technical and historical uniqueness—can be found in the *Shih Nung Pi Tung* of Sung times. Here the term 'butterfly eyebrow staff' *(e-mei-ckang[1])* is used, a term which we also found on the illustration of the *Nung Shu* edition of + 1530[e] (Fig. 227), and in the *San Tshai Thu Hui,*[d] to describe this particular part of the roller-system.

But before attempting any interpretation, we should look at the passage mentioning the butterfly eyebrow staff in the *Shih Nung Pi Tung* of the + 12th or + 13th centuries, which is the earliest reference:[6]

[1] This is the end of the text of the cold water silk-reeling pan quoted from the JVSGS; in the *JVSCY the* description continues explaining the structure of the furnace, the placing of the smoke-pipe..., but the important parts of the text have already been mentioned above.

» See Vol. 4, pt. 2, above, pi. CLIV.

[e] JVS (+1530), ch. 22, pp. 27ab. a *STTH, (Mi-yung),* ch. 9, p. 23b.

[e] *SNPr* quoted in the *NSCY,* ch. 4, p. 15a; in the *NCCS,* ch. 31, pp. 35ab.

[1] 蛾眉杖

Table 7. *Change of Terminology of the Various Functional Parts of the Silk-reeling Frame* (*sao-chhe-chhuang* 繅車床) *between +11th and 19th Centuries.*

	N. SUNG (+11th cent.)	S. SUNG (+12 to +13th cent.)	YÜAN (+14th cent.)	MING (first half +17th cent.)	CHHING (19th cent.)
PAN hot water / cold water	*ting* 鼎 (*TS*)	*fu* 釜 (*SNPY*)	*phan-tseng* 盤甑 (*NS*)	*kuo* 鍋 (*NCCS*) *phen* 盆 (*NCCS*)	
Guiding-eye	*chhien-yen* 錢眼 (*TS*)			*chu-chen-yen* 竹針眼 (*TKKW*)	*tso-ssu-yen* 做絲眼 (*TSTP*)
Roller[a]	*hsing* 星 (*TS*) *so-hsing* 鎖星 (*TS*)	*fu* 富 (*SNPY*) *chüan-tzu* 捲子 (*NSCS*)		*jao-hsing* 繞星 (*TKKW*) *chu-thung* 竹筒 (*NCCS*)	*hsiang-hsü* 響緒 (*TSCY*) *sao-hsing* 繅星 (*TSTP*)
Pulley	*ku* 鼓 (*TS*)	*tu-lo* 獨樂 (*SNPY*)			*mu-niang-tun* 牡孃鐓 (*TSTP*)
Eccentric lug	*yü* 魚 (*TS*)				*shuan* 閂 (*TSTP*)
Ramping-board	*thien-thi* 添梯 (*TS*)		*hsing-ma* 行馬 (*NS*)	*sung-ssu-kan* 送絲干 (*TKKW*)	*ssu-chheng* 絲稱 (*TSTP*) *chhou-chhiang* 抽鎗 (*TSTP*)
Guiding-hooks	*kou* 鈎 (*TS*)	*hsing-tao-chih* (*SNPY*) 行道枝		*sung-ssu-kan-kou* 送絲干鈎 (*TKKW*)	
Silk-reel	*chhe* 車 (*TS*)	*khuang* 軠 (*SNPY*)	*khuang-thou* 軠頭 (*NS*)		
Treadle	*tha* 踏 (*TS*)		*tha-nieh* 踏躡 (*NS*)		*tha-chiao-pan* 踏腳板 (*TSCY*) *hsieh-pan* 鞋板 (*TSTP*)

It indicates that in Sung times major innovations like the roller, pulley, and ramping-board took place; in Yüan times the achievements of Sung times were still in use but declined towards Ming times which made it necessary in Ming times to label the functional parts once again because the old names could no longer be understood.

[a] *Butterfly Eyebrow Roller*, see pp. 372–379.

Reeling silk. One worker is needed who takes at least about 15 cleared silk fibres from the 'old silk pin' (to which they had been attached after the preparatory work had been finished prior to reeling). Yellow silk is coarse, and so (if the silk is of this colour) the number of cocoons should be reduced. (The silk fibres from the cocoons) are gathered together in one place so that (when the reeling starts) they can pass through the guiding-eye. The place below the guiding-eye where the cocoons are gathered, is called cocoon assembly. Another name for it is stirring-pan. The threads wind twice round the top (roller) and twice round the bottom (roller) of the butterfly eyebrow. (Finally the threads) are drawn on to the silk-reel.[a]

Here we have first to ask ourselves whether this translation is the only one possible. To judge from the technical content this appears to be so. Translations which speak of winding over and under one staff only ask for what is a practical impossibility, but here we read about two staffs, one at the top and the other at the bottom of the roller-frame; winding over and under would therefore be possible in such a case.

How was the winding actually performed? In our opinion, the silk thread went through the guiding-eye and up to the top roller, then passed down to the bottom roller and was wound round it and after this was drawn up again, crossing over the downward length on the way (Fig. 228). This crossing-over took place before the top roller was reached. The thread was then wound once more around the top roller in the same direction as before, passed down to the bottom roller and wound around it again, finally being drawn through the hook on the ramping-board. The thread was therefore wound twice round both the top and the bottom rollers which were caused to rotate constantly in the same direction by the pressure and tension of the silk itself. The rollers probably were grooved to guide the thread.

This interpretation implies first that the butterfly eyebrow staff was a type of roller and second, that in the case of a roller-frame with a top and bottom roller arrangement—i.e. four rollers altogether—the normal name of the roller could be replaced by 'butterfly eyebrow top roller' or, conversely, the 'butterfly eyebrow roller' was nothing else than a special name for a roller. The only difference from other rollers lay in its special function which—as we shall see in a moment, had had nothing to do with its imaginative name.

The only Chinese scholar who commented on it was Hsii Kuang-Chhi and he did not understand it:[b]

Mr Hsüan Hu[c] says: 'Today the silk reeled everywhere is of the double winding *(shuang-chiao)* type; produced without the butterfly eyebrow roller. Neither Chhin Kuan

[a] The passage about the roller reads: *e-mei-chang-tzu shang Hang Mao chang-tzu hsia Hang chiao. kua yä khuang shang'.* •> *NCCS,* ch. 31, p. 35b.

[c] The *hao* of Hsü Kuang-Chhi was Hsüan Hu[2], see *EC,* pp. 316-19.

[1] 蛾眉杖子上兩繳杖子下兩繳掛於軠上 [2] 玄扈

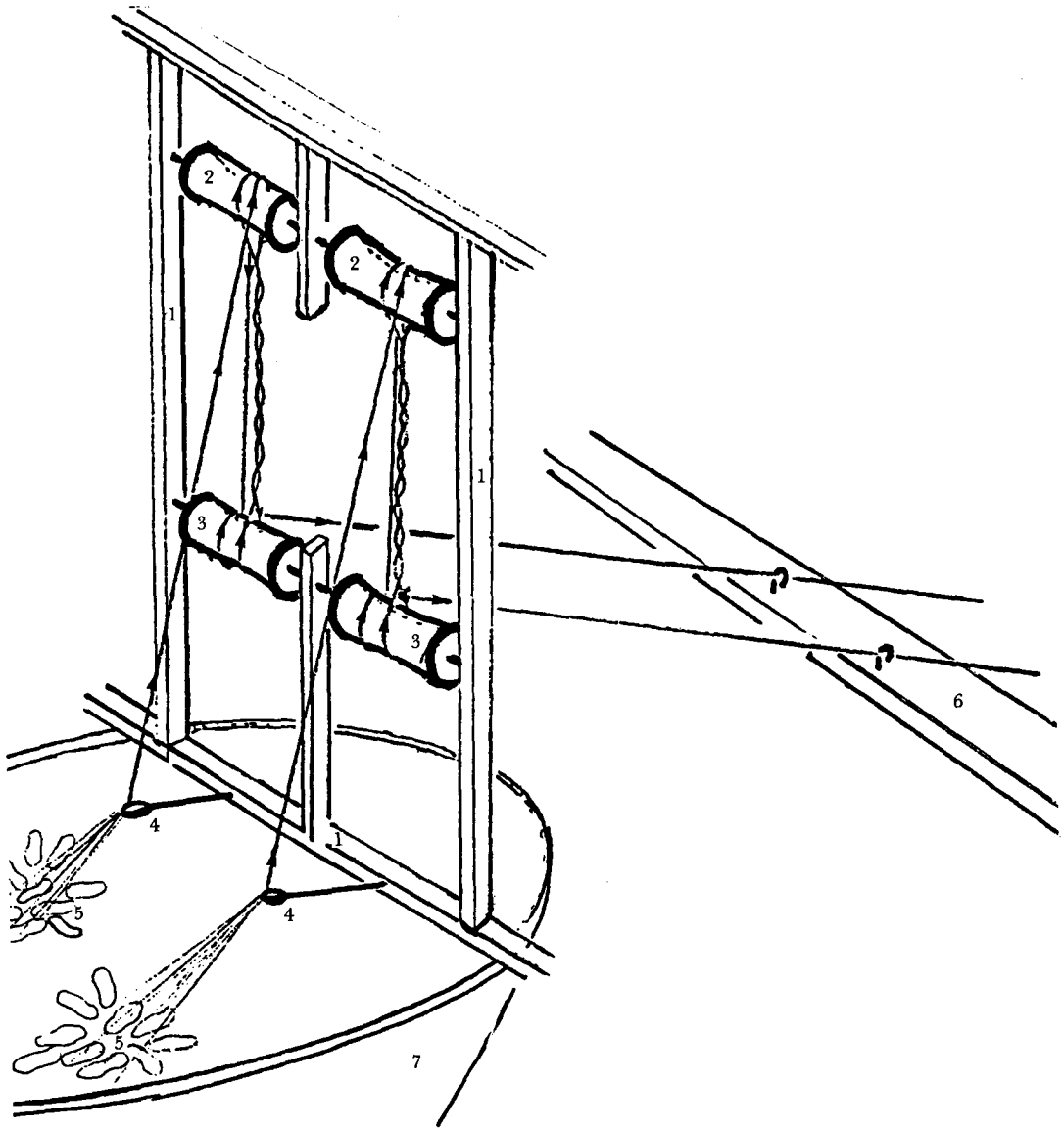


Fig. 228. Reconstruction of the 'butterfly eyebrow roller' and its function; sketch of the 'complete winding', Sung dynasty. > Direction of the silk threads towards the reel. 1, Roller-frame. 2, Top roller. 3, Bottom roller. 4, Guiding-eye. 5, Cocoon assembly. 6, Ramping-board. 7, Pan.

nor Wang Chen talked about the difference between the complete winding *(chhiian-chiao),* the double winding *(shuang-chiao)* and the single winding *(tan-chiao).* The old methods must have already gone out of practice a long time ago, and authors only copy from and shorten the old literature. I have not yet seen such a northern silk-reeling frame at the present time and I do not know whether it has a butterfly eyebrow roller or not. One should inquire into this one (piece of) equipment and have a look at it.'

Following Hsü Kuang-Chhi's advice we shall try to clarify the problem. To do so we have to consult Chinese sources again to find out about silk-winding techniques and how they influenced the quality of silk threads.

The three types of winding already mentioned by Hsü Kuang-Chhi are contained in the *Shih Nung Pi Yung*:[a]

When replacing[6] (new) silk (-cocoons for those already reeled off) they are added to the cocoon assembly, and have knots (where they are joined to the end of fibres which have already been reeled). When (previously) cleared silk fibres are fed with the fingers (to the end of a fibre already reeled off) in the cocoon assembly, (the 'old' fibre) naturally leads (the 'new' one) upwards and there no knot is (visible). This is called 'completely wound silk' *{chhiian-chiao-ssu[1])* which is round (in diameter) and firm without occhielli (eyes); it is first class quality for making gauze *(sha-lo[2])* and first class quality rolls of (patterned) silk.[0] When (the thread) has two windings on the butterfly eyebrow roller only, then it is called double wound silk *(shuang-chiao-ssu*)* which is elliptical, not so firm and has small occhielli; it is average quality, not suitable for making gauze but ordinary quality rolls of (patterned) silk. When (the thread) has only one winding, then it is called single wound silk *(tan-chiao-ssu*)* or mouth-rest silk *(hsieh-khou-ssu[5])* which is flat (in diameter) and uneven with large occhielli; it is not suitable for making rolls of (patterned) silk cloth but simple tabby weave silk fabrics *(chiian-po[6]),* the quality of which is not strong and lasting. This single-wound mouth-rest silk is mostly reeled from hot water pans.

This text cries out for a commentary because otherwise we cannot get the facts straight. First of all

the use of previously cleared silk to produce the silk thread having the 'complete winding' has nothing to do with the quality of the silk fibres generally, but has very much to do with the economic efficiency of silk-reeling. When the beginnings of the fibres are cleared off in an auxiliary pan prior to the reeling process, then adding new cocoons into the cocoon assembly is easier to manage and there is less waste silk. This is because clearing involves taking away the rough parts at the start of the fibres so as to avoid irregularities in the silk which is to be reeled off. This working step could be performed more thoroughly in an auxiliary pan than in the reeling-pan, because it did not interrupt the reeling work.

Secondly, joining new fibres to 'old' mostly occurred as described in the text. Otherwise it would mean that those working at the reels intended to reduce the quality of silk threads deliberately, which certainly cannot be assumed. Thirdly, the term 'mouth-rest' silk most probably means an inferior kind of silk or silk thread. In our opinion the anonymous author was most likely referring to silk thread which was not reeled continuously. Frequent stoppages occurred when new cocoons were put into the pan. The word 'mouth' was a reference to the open aperture of the pan. We should, of course, not

[a] *SNPY* quoted in the *NSCT*, ch. 4, p. 15a: it is printed as a commentary to the text; see also *NCCS*, ch. 31, p. 35b.

[b] *Thien ssu*[7], 'increasing silk' has to be understood as translated above.

[0] *Phi-tuarfi* has been translated as 'rolls of (patterned) silk'. See also *NSCY*, ch. 4, p. 15a where we find /«an" in **the** sense of *tuan-phi*[10], patterned silk piece-goods.

[1] 全緻絲 [2] 紗羅 [3] 雙緻絲 [4] 單緻絲 [5] 歇口絲
[6] 絹帛 [7] 添絲 [8] 疋段 [9] 緞 [10] 緞疋

conclude that all silk tabby fabrics were woven from this type of silk, but only that such silk could be used only for tabby weaves.

Finally, the difference between different qualities of silk thread lies in the number of windings. The 'completely wound' silk cannot simply be defined by the fibre-joining process in the pan but, as the term indicates, is a characteristic of the sort of winding which had to be performed, as in the case of double wound and single wound silk thread.

We have to return to the roller-system to explain.

Our explanation of the various silk thread winding systems follows.

Complete Winding. The silk thread with the 'complete winding' *(chhiian-chiao)* was produced from a cold water pan[a] with a system consisting of two top and two bottom rollers (Fig. 228). The worker reeled previously cleared silk cocoons, the pan itself containing two cocoon assemblies, each with about 15 to 20 cocoons.[0] By the technique of crossing over and winding twice round both the top and the bottom roller, the silk was given a round shape and made even throughout its length.

There is no doubt that the butterfly eyebrow roller system worked in making the complete winding,[0] but was probably too difficult and too slow to be used constantly in the silk-reeling season. In the opinion of the Chinese, fast reeling produced better quality silk and was more economic. It is quite reasonable, therefore, to suppose that they replaced the working step performed by this device by a simpler reeling process and more attentive spooling. With increasing demands for silk production, the complete winding lacked economic efficiency, lost importance and finally disappeared, probably as early as late Sung times.

Double Winding (Fig. 229). The silk thread with the double winding *(shuang-chiao)* could most probably have been produced from both the cold water and the hot water pans. The cocoons did not have to be first class.[d] There certainly was a top roller round which the two windings took place but it remains an open question whether this roller only was employed or whether a bottom roller was added so that the reeled silk described a figure as depicted on the illustration of the *Thien Rung Khai Wu* (Fig. 236). In this case a simple crossing-over method should not be excluded; it is certainly a technical possibility.

Double wound silk thread could not give the same roundness and evenness as that produced by the complete winding method, but it was faster to produce and had an economic value for silk-reeling households. Quality gradation may have occurred in the spooling process.

Unfortunately Hsü Kuang-Chhi did not explain the double winding although it was in use in his lifetime.

Single Winding (Fig. 222). The silk thread with the single winding *(tan-chiao)* was reeled from the most common, cheapest, and economically most efficient hot water pan. The roller-frame had only one set of rollers, as can be seen on most illustrations of silk-reeling frames. Single winding has to be understood as having the thread running over the roller, because no real winding round it was done.

[a] *NS,* ch. 20, p. 31a.

[b] To produce silk threads for gauze weaves, 20 cocoons were used to form one thread in Ming times, see *TKKW,* ch. *shang,* p. 30b.

[c] We have tried out the system and it does work, but it was certainly not easy to operate when producing silk threads on a large scale. To counterbalance the tension from the reel, many cocoons—soaked with water in the pan—were required.

[d] *NS,* ch. 20, p. 31a.

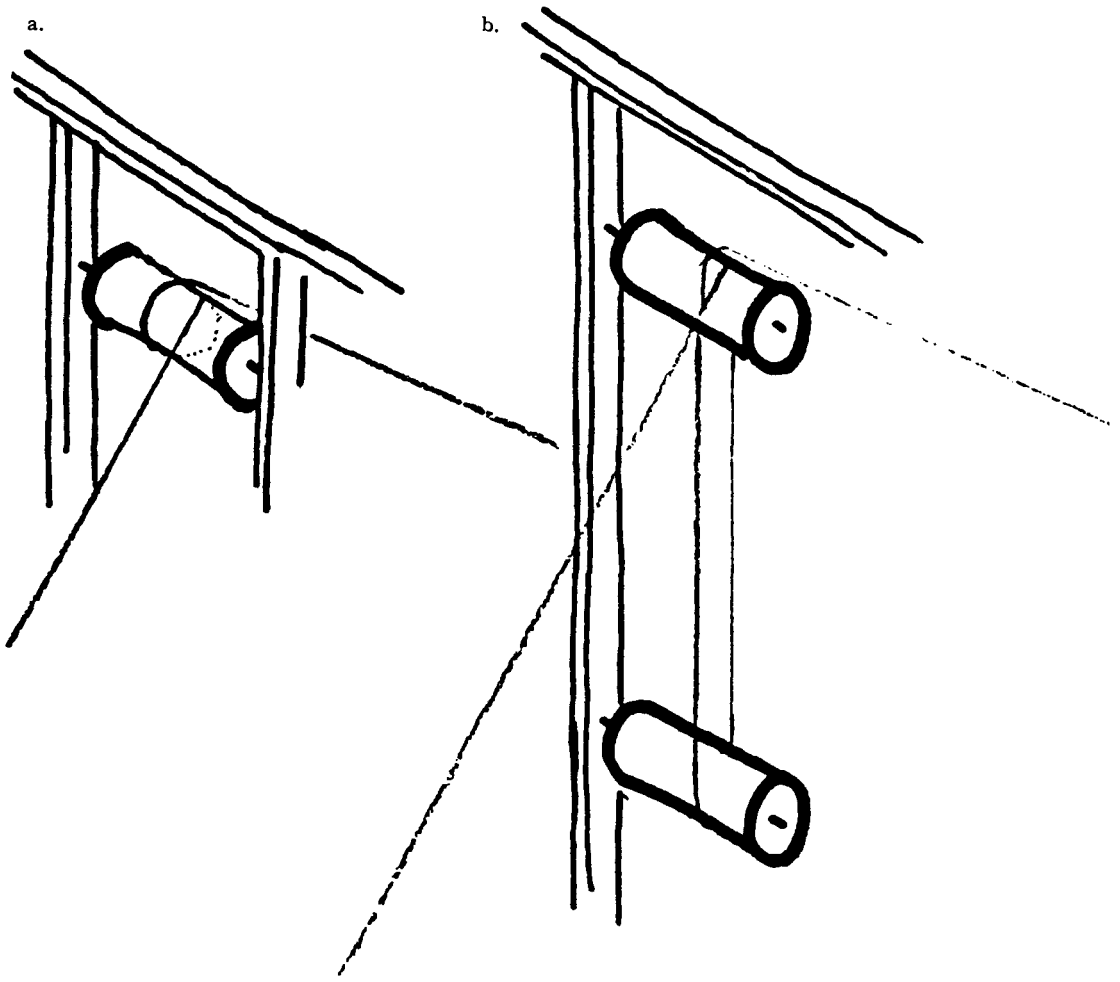


Fig. 229. Two possible methods of double winding silk threads; sketch of simplified rollers and roller-frames, Sung period. a. (left); b. (right) showing the method depicted in the *TKKW*; self-crossing is not performed, but should not be excluded as a winding possibility.

The quality of such thread could not compare with the other two kinds, but its reeling system was the easiest to work and, because of its efficiency, geared for mass production. One should also keep in mind that the quality produced depended to some extent on the cocoons reeled off and on the experience and skill of the operator. We may say, then, that the silk reeled off on this frame ranged from better than average to inferior qualities.

About the history of the roller generally, and the butterfly eyebrow roller in particular, we can only make a conjecture. That 'butterfly eyebrow roller' was just another name for the roller—which perhaps originated in a northern silk producing area—is obvious. The term may have derived from the appearance of a sort of predecessor of the roller, a type of spindle fixed to the middle post of a simple frame, making the spindles themselves appear like eyebrows (Fig. 230).

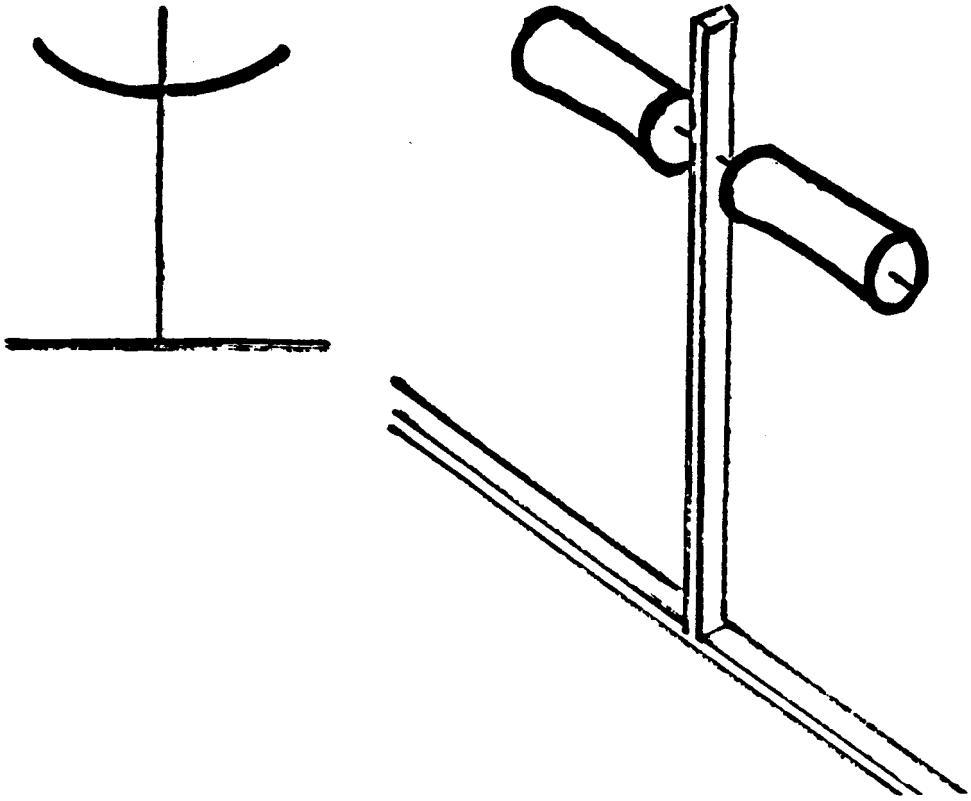


Fig. 230. Pre-Sung 'butterfly eyebrow rollers'.

Thereafter, the spindles could have become the axles of the roller tubes. And still later, or perhaps at the same time, this type of roller-frame was probably replaced by the type known to us from the illustrations, with the rollers supported between two posts. So eventually, and certainly at least as early as the +nth century, the butterfly eyebrow roller had already lost the characteristic eyebrow-shape after which it had been named. This guess would explain why though the name was transmitted, no sufficient explanation was ever provided. Indeed, the scholars in Sung times, as we have realised from the textual evidence, had only a very ambiguous conception of it.

(y) *The Soundless-roller Silk-reeling Frame*

Another type of advanced silk-reeling frame with a separate roller-frame which was used in Sung times or even earlier was the soundless-roller frame *{wu-sheng-chhe*[1]*).** From an historical point of view it can be regarded as the joining link between other advanced frames and the simple reeling devices as they are pictured

» Kuhn (7), pp. 82-4.

[1] 無聲車



Fig. 231. The soundless-roller silk-reeling frame, + 1742. *PFKI*, ch. 2, p. 55a.

on the handscroll 'Silk-workshops in the Quarters of the Palace Ladies' by Chhiu Ying of the + 16th century (Fig. 217) and in the *Pien Tung Hsiieh Hai Chhün Tii* of + 1607 (Fig. 218). This frame which seems to have developed from such simple devices may have been a hand-operated hot water reel with two long posts and a crossbar at the top, and provided with a hook to guide the thread. It was perhaps similar to the reeling device of the *Keng Chih Thu* (Fig. 221). In all probability it was only a small step to make this hook movable with the help of a movable crossbar—which arranged in this way actually acted as a ramping-board.

Unfortunately, this type of frame did not attract Chinese authors **and no detailed** description of the whole device is available. In consequence we shall start by introducing its significant component parts (Fig. 231 ; Fig. 232). A tall upright post was **fixed in** the ground, and to it were attached the silk-reel axle, two horizontal **holds, and** one horizontal crossbar. The spokes were arranged on one side of **the axle,** and a cogwheel was fixed on the other end so that it revolved on the same axis as

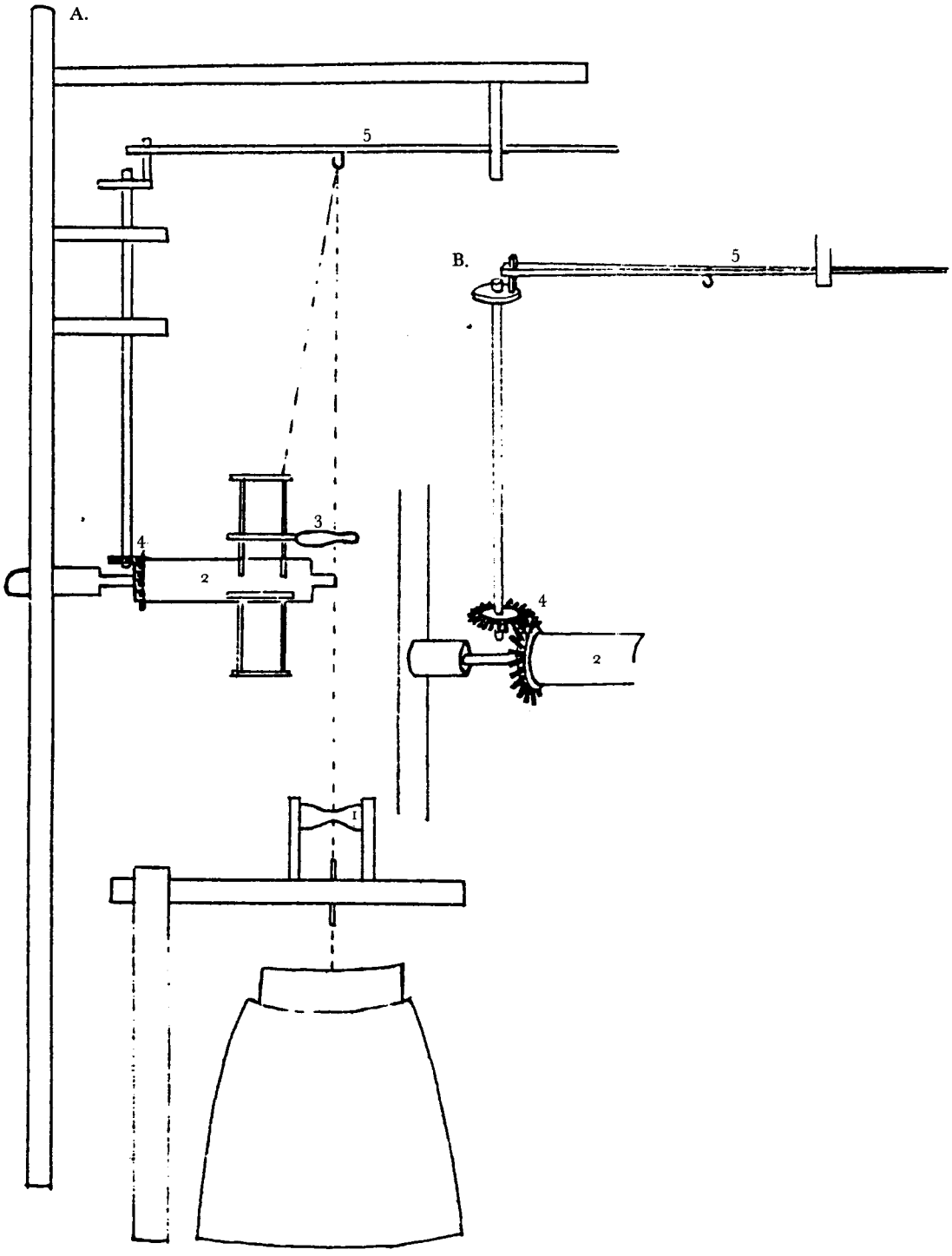


Fig. 232. Technical drawing of the soundless-roller silk-reeling frame. A, Front view. B, Toothed wheels and ramping-board. 1, Soundless-roller. 2, Silk-reel axle. 3, Handle. 4, Toothed wheels or cogwheels. 5, Ramping-board.

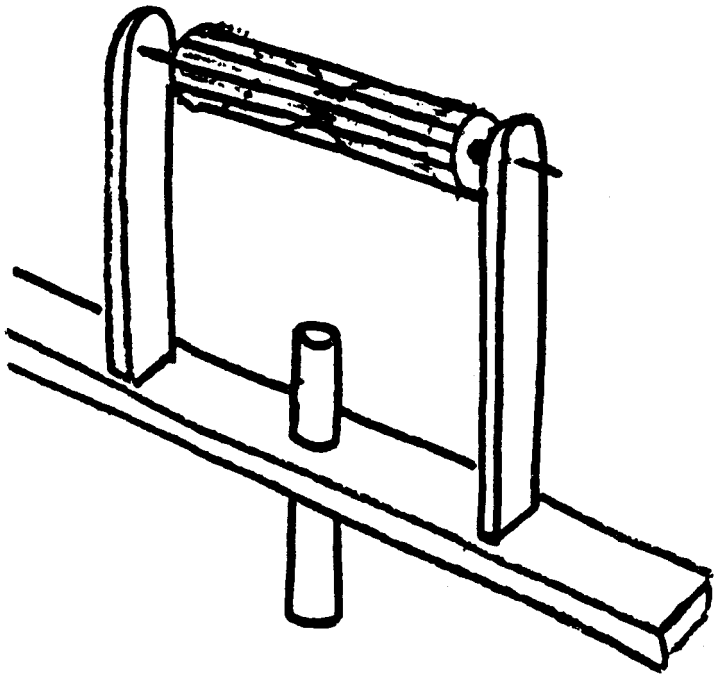


Fig. 233. Sketch of the soundless-roller, Chhing dynasty.

the silk-reel, which was driven by hand. Another cogwheel at the base of a vertical axle interlinked at right angles with the first. Thus when the silk-reel was set in motion, the vertical axle revolved too. At the top of the vertical axle a horizontal wheel was fixed with a handle at its edge; this transformed the continuous rotary motion of the vertical axle into a rectilinear motion of the ramping-board. The other end of the ramping-board passed through a hole in a hanging arm which was joined by a horizontal crossbar to the upright post. This was a very simple but original idea, resulting in a ramping-board which guaranteed the same results as the more complex silk-reeling 'machine'.

Why did the Chinese call this 'the soundless-roller'? Wei Chieh, the author of the *Tshan Sang Tshui Pien* (General Compendium on Sericulture) of +1899, answers the question:[a]

The soundless-roller (Fig. 233). (When applying) the old method, an iron spindle (used as an axle) perforated the bamboo tube, or a wooden spindle was used to pass (as an axle) through the roller (made of iron). If there was any stoppage when (the roller) rotated, the noise was very (loud so that) the ear was stunned by the hubbub and (this) did no good (to the silk).

Nowadays a reeling-roller is manufactured which does not make a noise. The new method uses a wooden stake with a square section of 4.8 cm and a height exceeding the rim of the reeling-pan by some 16-19 cm, which is planted into the ground beside the

» ***TSTP*, ch. 4, pp. i6ab.**

pan. Near its top, a horizontal bar with a square section of 4.16 cm is fixed. It stretches across the pan.

Two small upright sticks with a height of 12.8 cm are arranged on it just above the middle of the reeling-pan at a distance of about 9.6 cm from each other. Nearly at the top of the sticks a fine bamboo spindle resembling a hairpin is inserted horizontally. (This hairpin) perforates a light 'bottle-gourd' roller (so acting as its axle, made of) the peel from the bottle-gourd. To manufacture it, one uses two round pieces of botde-gourd with a diameter of some 3.2 cm (arranged in such a way that the outer ends) are at a distance of 9.6 cm from each other. Near to the edges (of the pieces of bottle-gourd) are fine bamboo pieces, (fine) like hairpins, inserted all around so as to form the shape of a round (cylindrical) basket. In the centre of the two bottle-gourd pieces a hole is drilled to take a bamboo tube which is perforated by the fine bamboo axle. (This construction) guarantees that the roller does not stop when once rotating.

(Just under this roller) a hole the size of a bean is drilled through the horizontal bar to take a short bamboo tube. Under the (horizontal) bar it reaches a length of some 9-12 cm.

This roller does not need a guiding-eye (because the bamboo tube acts as such). When reeling, the beginnings of the silk fibres are taken up with the sharp points of the bamboo brush. (The fibres) are drawn from (the reeling-pan) through the tube up towards the roller and are combined into one thread. This silk-roller works without metal. It rotates extremely lightly and fast; the advantage of using it is (that it is) without comparison (and also it works) without noise.

With help of this detailed explanation of the soundless-roller it is very easy to imagine how it operated. But what do we know about its history? According to the text of the *Tshan Sang Tshui Pien,* which is taken from the *Pin Feng Kuang I* of + 1742 without supplying the proper reference,* we have it confirmed **that the** rollers used in the 'old' method made quite a noise as was already stated by **Fan** Chheng-Ta[1] (+ n 26 to +1193):[0]

When the wheat is green and luxuriant
and the barley yellow,
Every morning at sunrise
when the air is still cool,
The girls and women exchange few words,
they have much work to do;
The odour of cocoons boiling behind the shed
comes through to the front of the gate.
The reeling-frame creaks
like rain spattering in the wind.
The cocoons are fat and their long filaments
reel unbroken threads.
How shall we find the time this year
to weave silk clothes?
Tomorrow we will go to the Western Gate
and sell the raw silk.

» *PFKI,* ch. a, pp. 54b-s6b.

» *Shih Hu Chü Shih Shih Chi,* ch. 3, p.$_4$a.

[1] 范成大

From + 18th and 19th century texts we gain the impression that the soundless-roller was an invention of the Chhing dynasty. But it was not. A stanza in a poem by Su Tung-Pho[1] (+ 1037 to +1101) tells us that 'the rollers are made of split gourd, and the vats of earthenware'.* This means the invention is at least as old as Sung times and that the split gourd *(pho-phiao[2])* contains the secret of its function.

Su Tung-Pho, a native of Szechwan and a keen observer of traditions and daily life of the people, had certainly seen this type of silk-reeling device in Szechwan province, though whether it originated in Szechwan or southern China cannot now be decided. Evidently the device must have worked extremely well. It was designed for hand-reeling on a small scale as was mostly practised in pre-modern China, and another of its advantages was the ease with which it could be transported from one place to another. This was important in a seasonal business, where a shortage of good machinery was always occurring. It should not surprise us, then, to find the frame reported in north China in Chhing times.

(ii) *The Economy of Silk-reeling in Sung Times*

Certainly we cannot deal in any depth with the silk economy of Sung times; that would require a separate study. Nevertheless there are two reasons why we decided to make a few remarks about this important subject. First, though there still exist pre-Sung sources to tell us about various activities, and particularly weaving, which took place in the field of textile technology and workshop organisation, we hear nothing about the economy of silk-reeling.

Before the Sung production of silk was to a large extent under official control and pretty much centered in the cities,[b] constituting a commodity for paying taxes and covering the producers' own needs. Silk commerce started to gain nationwide importance during the Thang and developed into an expanding trade in Sung times. Then the traditional centres of silk production of Chou times, such as Shantung, Honan and Hunan, were followed by the rise of silk manufacturing in Hupei and Szechwan and, round the middle of the + ist millennium in Kiangsu and Chekiang. In Sung times many silk weaving regions are reported to have specialised in one kind of fabric or another.[0]

Secondly, so far as we have been able to outline the historical development of silk-reeling machinery, the Sung dynasty appears to be the period in Chinese history during which outstanding innovations in the art of reeling occurred. These were probably caused by the practical and fashionable demands due to a highly sophisticated taste among the upper-class population in the capital Khaifeng and later in Hangchou, which created new standards of living and behaviour.[d] The

» *Su Tung-Pho Chi,* vol. 2, ch. i, p. 7.
[0] *Ibid.,* p. 112. The subject will be dealt with in vol. 5, part x.
» Shiba (1), p. in.
<* Gernet (2).

[1] 蘇東坡 [2] 破瓢

Table 8. *Table of Average Value of Circularity Coefficient* (1), *Cross-sectional Area* (2), *Degree of Lousiness* (3) *of Fibres at Various Historical Times, as well as the Limiting Width in the Average Value of the Circularity Coefficient* (4), *Cross-sectional Area* (5)

Source: Nunome (*2*), p. 37, table 2.

	i	2 (^)	3	4	5	6 (Number of specimens)
Han/Lo-lang	50.8 ±1.98	46.3+5.78	0	±3-73	±4-92	28
mm						
Thang	56.1 ±1.57	70.815.48	0.38 + 0.31	±3-50	±5-41	29
Sung	61.3+ 1.08	IOO.5 ±4.94	0.29 + 0.13	±4.17	±9-!4	55
Yuan	61.0 + 0	74-3 + 0	0	+ 3-07	±5-30	1
Ming	62.2 ±2.90	111.4 ±9.97	0.08 + 0.16	±346	±8-57	13
Chhing	60.0 ±3.79	87.0+ 12.09	0.38 + 0.40	±3-8i	±7-55	10
Republic	62.6+ 1.24	136.4! 16.76	1.08 + 0.39	±3-74	±740	16

upper classes included aristocrats, scholar-officials, merchants as well as the *nouveaux riches*, and to keep pace with what they wanted meant improving agriculture and sericulture and having a better standard of technical equipment. These were necessary also to satisfy the government's need for more silk and silk fabrics to be paid as tribute to the 'barbarians' in the north in order to maintain peace on the northern frontier, enormously expensive though it was.[a] As a result silkworm breeding and rearing techniques were improved, novel grafting methods for mulberry trees were successfully applied[15] and the new techniques of silk-reeling just described, were propagated in books and handscrolls so as to make them widely known and enable them to be put into practice. All these efforts resulted during Sung times in the production of silk thread better in quality than ever before. Nunome Junrö[c] has made a scientific analysis of the silk in such old Chinese fabrics as were available to him in Japan[d] some twenty years ago when he published his significant monograph. He showed that these fibres indicated considerable variety in their properties, their reeling and processing, and in place of production. Furthermore he pointed out that the coefficient of circularity and the cross-sectional area of the fibres became larger with time due to new techniques and new breeds of silkworms. Changes in the coefficient and in cross-section, shown in Table 8 and in Figs. 234 and 235, indicate the superiority or inferiority of the various sericultural techniques used at different historical times, and thus seem to indicate a rise and fall in sericulture.

From Nunome's statistics we can see that silk quality reached a peak about

*** In the peace treaty of Shan-yuan in +1004, the Sung agreed to pay to the Liao 200,000 bolts of various silk fabrics—apart from other items. This amounts to a length *ofc.* 3,400 km of silk fabrics.**

•> Chang Khai (/), p. 119; Chao Ya-Shu *(2),* pp. 178-9.

[c] Nunome *(2).*

[d] The number of specimens available to Nunome was rather limited, but future research in this field will doubtless back up his preliminary results.

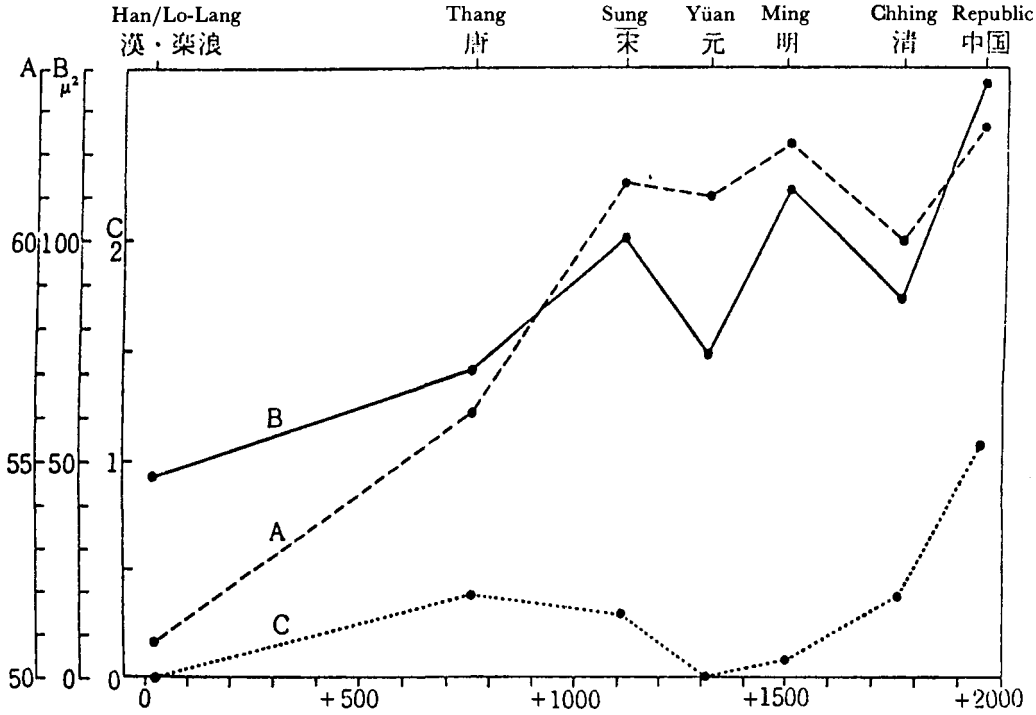


Fig. 234. Graph of changes in the average value of coefficient (A), the average value of cross-sectional area (B) of all specimens and the degree of lousiness of fibres (C) in Chinese silk fibres in various periods. Nunome (2), p. 34, fig. 5.

+ iioo during the Sung, and then declined in Yuan times (though only one sample was analysed from this period). Quality seems to have recovered about + 1500 during the Ming and declined again in the Chhing. These statistics clearly mirror the enormous consequences which Sung silk technology had on pre-modern silk manufacture in China.

Though many textile technological improvements had taken place before Sung times, the processes of making silk and silk-weaving still remained labour intensive. However, the nature of silk-production resulted in a division between rural and urban silk activities. Rearing silkworms and reeling silk constituted a seasonal occupation in rural areas where extended family households could provide the workforce required.* But the rural community generally suffered from a shortage of money and so sold the surplus silk—if not all the silk they prepared—to itinerant merchants, who acted as middlemen, profiting from the job themselves and distributing the raw silk to urban weaving and dyeing centres.

Even the important and famous *Ling-chin-yüan*[1] (Government Workshop of Patterned Silk-fabrics), established in +967 in the capital Khaifeng, and the

» Sheng (1) has composed a profound study on 'Lo: Textile Technology and Socio-Economic Conditions in the Lower Yangtze Region in the Sung (A.D. 960-1279)'. The study is unpublished.

[1] 綾錦院

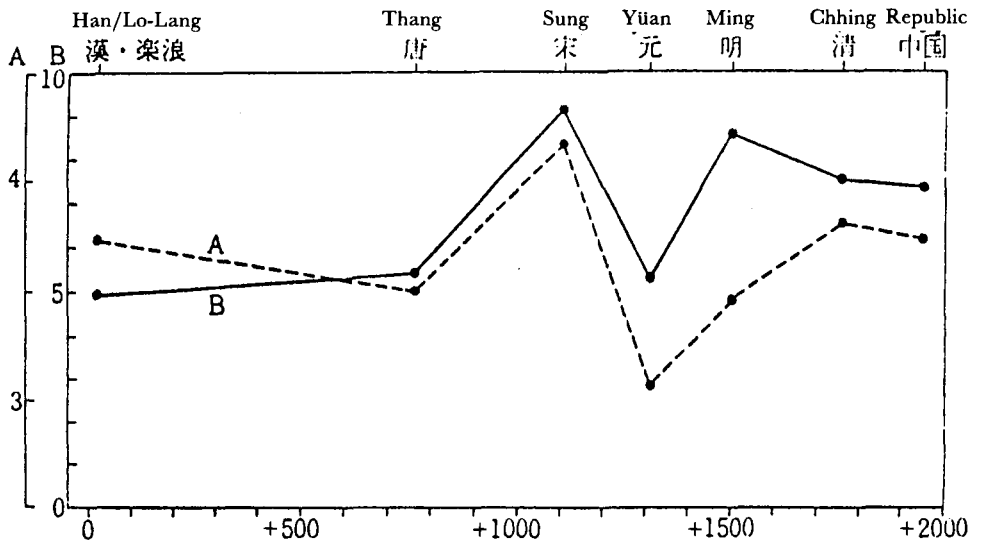


Fig. 235. Graph of changes of the 'width of actual limitation' in average value of the circularity coefficient (A) and the cross-sectional area (B) in Chinese silk fibres in various periods. (The 'width of actual limitation' means the difference between the largest and the smallest result.) Nunome (*2*), p. 36, fig. 8.

Chin-yüan[1] (Government Workshop of Brocades), founded in +1083 in Chhengtu, Szechwan province,[a] had no silk-reels, and probably obtained their raw material from government stores.

Only affluent rural households could have had the financial resources allowing them to run their own weaving workshops and manufacture better and more valued weaves than the ordinary tabby fabrics paid as tax in kind. In the cities, where financial power was concentrated, weaving workshops equipped with the then most advanced looms in the world and operated by highly skilled weavers, produced a variety of refined, elegant and tasteful fabrics—in their general standard superior to most fabrics woven before and after Sung times. What, then, occurred in the developed areas of silk production to produce sufficient raw silk to meet this greatly increased demand? Certainly, the cultivation of mulberry trees was intensified, but silkworm rearing was also improved, and new types of silk-reeling frames were set up.

As Lillian M. Li has pointed out in her study,[b] the conversion ratio between cocoons and grège silk, domestically reeled, was always within the range of 1 o to 13:1. When reeling from dry cocoons, however, the ratio changed to 4.5-6:1, because the cocoons lost weight in the drying process.[0]

* *Sung Hui Tao Kao, (shih-huo),* 64, p. 16b, also mentioned in the *Tung Ching Meng Hua Lu,* p. 30 ; for the *Chin-yüan,* see *Shu Chin Phu.* A highly informative study—including various notes on the textile manufacture in Sung times, the organisation of workshops and the life of male and female weavers—constitutes an article by Eichhorn (14), pp. 169-202.

[b] Li (1), pp. 32-3, esp. table 3 Yields: Cocoons to Raw Silk.

" *Ibid.;* Anon. *{740),* p. 269; Anon. *{739),* p. 108; Lieu (1), pp. 136, 138.

[1] 錦院

In Sung times the conversion ratio ranged from about 12 ounces (304.19 g) of fresh cocoons to 1 ounce (28.35 §) °f[raw] silk.[a] From the *JVung Shu* by Chhen Fu of + 1 i49,[b] we know that a family consisting of ten persons, who reared 10 frames of silkworms, could obtain a yield from each frame of twelve catties of cocoons. From each catty (596.82 g) 1.3 ounces (48.49 g) of grège silk could be obtained, and from 5 ounces (141.75 g) of grège silk a small bolt of *chiian*[1], a light silk fabric in tabby weave, was woven.[0] Every bolt could be exchanged for 1.4 piculs *(c.* 93.3 kg) of rice. The total amount of grège silk produced by the family would have been around 5,800 g. To produce this with normal hand-driven equipment it was necessary to use three silk-reels for 10 days.[d] In Chhing times the traditional treadle-machine of the large type widely used in Chekiang and which, because of its size, was operated by men, reeled 12 to 13 ounces (some 368 g) of raw silk daily.[e] Unfortunately, the figures are not really comparable because we have almost no information about the quality of silk reeled: we do not know whether it was fine silk thread consisting of five or six fibres, a heavy silk which fetched a high price combining 12 or 13 fibres into one thread, or thick silk with more than fifteen fibres to a thread.* Nor do we at present know anything about its cross-section, whether it was round or elliptical, and if its appearance was clean and lustrous. To answer these questions Chinese scholars need to analyse the silks excavated in recent times and so obtain a series of data which provides information that can be interpreted scientifically in terms of an historical evolution.

Assuming that the quality of silk reeled on the hand-reel and on the treadle-operated reel were similar, the latter could process almost two and a half times as much as the former. Although the treadle-reel was efficient, it hardly could satisfy the large silk-reeling households. In the *JVung Cheng Chhiian Shu* we read[g] that it was considered most economic to operate with five workers at the same time, and employ two silk-reeling frames. Two persons executed the preparatory work of picking up the ends of the fibres in small pans, two reeled the silk, and one worker attended to the fires in the stoves. In this way it was possible to reel off almost 18 kg of cocoons per frame per day. That would produce around 1430 g of grège silk depending on the cocoons, the quality required and the weather conditions. One treadle-operated frame worked by one person who had to attend the reeling process as well as the preparatory work and the fire, could only yield 480 g a day, reeled from about 6 kg of cocoons. This means that, even if 5 silk-reels were at hand and 5 skilled workers operated the frames, the daily output was only about 2400 g of grège silk instead of 2860 g resulting from the use of two frames and a division of labour. So this method was not only more efficient but also

[a] Kuhn (7), p. 79. [b] *Nung Shu,* ch. *hsia,* pp. 4ab.
[0] A bolt of five ounces is only about half of the weight considered as tax payment in Sung times; see *Sung Shih,* ch. 128, pp. 4231-2.
[d] Sun (3), p. 13. « *Ibid.,* p. 12.
' *SILK,* p. 57; Sun (3), p. 12. e *XCCS,* ch. 31, pp. 350-363.

[1] 絹

less expensive when employing two skilled hands instead of five and two silk-reels instead of five. Unfortunately we have no textual evidence for such a division of labour in Sung times, but we may assume that wealthy silk breeders organised the silk-reeling in this way.

So it becomes clear that it was the employment of the treadle-operated reel in combination with the organisation of labour, which made silk-reeling efficient and increased the output of raw silk in Sung times.

The economic necessity of reeling silk in large quantities within a limited period also had effects on the development of the cross-over techniques. There were several cross-over methods in use as has been mentioned, and in all probability they were confined to north China, in particular to Shantung province in Northern Sung times. From the sources, it can also be concluded that 'complete winding' was bound to fail. This was because the method could only work out when the operative had already gained some experience with this type of reeling and had in addition a well-developed flair for balancing the tensions. This was essential when rollers were arranged without any knowledge of trigonometrical ratios, the application of which immensely simplified the difficulty of arranging the rollers from the 19th century onwards.[8.]

Because China always suffered from a shortage of skilled and experienced operators, and silk-reeling in the past was even more a seasonal business than it is today, the amount of silk produced with this cross-over method must have been insufficient compared with the output of silk on a silk-reel without the complex roller-system normally used. With the invention of a cross-over system, the Chinese had certainly taken a step in the right direction and may have succeeded as far as the quality was concerned, but high standards did not compensate for demands in quantity, which were what made financial profit. As a result the importance of producing first class silk was reduced, and finally forgotten, especially in the centuries after + 1300. Craftsmanship in textiles had reached its zenith in the Sung dynasty, and never quite recovered thereafter.

According to Chhin Kuan, who distinguished between the silk-reeling technology of Shantung, southern Kiangsu and northern Chekiang, the advanced northern silk-reeling techniques have spread to the south during the +i2th century. Most probably this expansion must be seen in connection with the collapse of the Northern Sung dynasty in the third decade of the + 12th century, and the shift of the capital and court from the north of China to Hangchou, established as the centre of the Southern Sung dynasty in +1135. Among the refugees from Shantung, Hopei and Honan who escaped the Ju-chen[1] barbarians[1]* who founded the Chin dynasty in + 1115 and who occupied now the north of China, were qualified technicians and members of families loyal to the Sung empire. It was they who could have introduced northern silk technology to

» Suzuki Saburö (/), pp. 80-92.

[b] Chang Chia-Chii (2), pp. 50-1, 126.

[1] 女眞

the south, so it should not surprise us that Liang Khai painted the northern device at the court at Hangchou.

(iii) *The Complete Silk-reeling Frame of Ming Times*

There are various later descriptions of the 'complete silk-reeling' frame as pictured in the *Thien Kung Khai Wu* of + 1637 (Fig. 236). This is defined because of the way its various structural parts are arranged. With the exception of the pan, all these parts belonged to the working system of the frame, all functions were integrated, and no further equipment was necessary.

The rather late pictorial and textual evidence of this equipment suggests the correctness of the assumption that it developed from the 'silk-reel frame with the roller-frame on the pan' as used in Sung times and later. In consequence the complete frame should be regarded as a type standing at the end of a long historical development of hand or foot-driven silk-reeling devices; technically best equipped for silk thread production in late Ming and Chhing times, it was obviously geared for mass production of silk. The industrial design of the frame (Fig. 237) manufactured in special workshops by highly skilled and trained craftsmen considerably limited the field of activity of the operator working the silk-reel. He or she was no longer concerned with the arrangement of the rollers, the guiding-eyes etc. ; all that was pre-arranged within the system of the frame itself with the result that they could just concentrate on the reeling. Such a 'perfect machine' and the skill of the workforce certainly resulted in high efficiency in the silk-reeling business; indeed, in terms of the actual work at the reeling-pan, it was only a small step from the complete silk-reeling frame to the steam-powered machine. What is more, though the muscle-driven reel was replaced by one which was steam-driven, the reeling-pan still remained.

We find the complete silk-reeling frame described in the *Tshan Sang Ho Pien* of + 1843,* [mtne] *Tshan Sang Chi Too* of + i87i[b] and in the *Kuang Tshan Sang Shuo Chi Pu* (Supplemented Edition of the Broader Explanations on Sericulture) of + 1875.[0] All three are in the same pictorial tradition.

The most detailed and reliable source is in the *Tshan Sang Tshui Pien* of + 1899.[4] It provides us with clear terminology for the parts, with all their measurements, and describes how they fitted together. So it appears worth quoting it at some length (Fig. 238). It says:[e]

The framework of the silk-reel *(chhe-chhuang[1])* is built of sandalwood *(than[2])* in a square shape.'

» ***TSHP,*** ch. *thu-shuo,* p. 2a. [b] *TSCT,* ch. *thu-shuo,* p. aa.

[c] The *KTSS* by Shen Lien[3] was ready for printing in + 1855 and was published in + 1863. Unfortunately only the + 1875 supplemented edition by Chung Hsueh-Lu" was available to us, *KTSSCP,* ch. 2, pp. 3gab.

" ***TSTP,*** **ch. 4, pp. I4b-i6a.** [e] ***TSTP,*** **ch. 4, pp. I4b-i6a.**

' **The sandalwood is mentioned in the *KTSSCP,* ch. 2, p. 39b. It should be understood as a hard and tough wood.**

[1] 車牀 [2] 檀 [3] 沈練 [4] 仲學輅

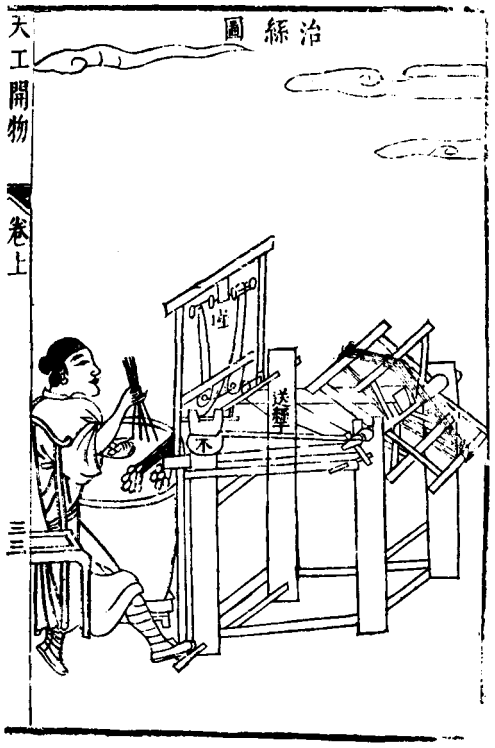


Fig. 236. Complete silk-reeling frame, + 1637. *TKKW*, ch. *shang*, p. 33a.

The posts *(chu*[1]*,* also called *tun*[2]*)** at each of the four corners are joined by top and bottom cross-rails *(heng-tang*[3]*)* to the four sides (of the frame). At both ends of each cross-rail are square tenons *(fang-sun*)* which are inserted into the posts. The cross-rails of the front and rear are equally long (being) about 43.52 cm. The connecting-rods on the left and right side are equally long: some 33.92 cm. Their tenons are inserted into the posts and their length must be added to the measurements of the connecting-rods and cross-rails given above. The distances of the left and right top and bottom connecting-rods differ from (the distances) to the ground of the front and rear top and bottom cross-rails. The left and right bottom connecting-rods *(hsia-tang*[5]*)* are about 5.76 cm from the ground. The top connecting-rods *(shang-tang*[b]*)* are some 45.44 cm from the ground. The front and rear bottom cross-rails are about 9.6 cm from the ground. The front top cross-rail is some 48 cm from the ground and the rear top cross-rail is about 28.8 cm from the ground. The distance of the rear top cross-rail from the ground is very low compared with the front top cross-rail and the top connecting-rods. (It is made this way) because the bearing of the silk-reel axle is on top of the two back posts. The top cross-rail there has to be arranged to be low. so that there is enough empty space above it to allow the spokes of the reel to rotate (without hindrance).

At the top of both back posts the bearing *(sun-khou*[7]*)* to take the silk-reel axle lies

* *TKKW*, ch. *shang*, p. 33a.

[1] 柱 [2] 不 [3] 橫檔 [4] 方榫 [5] 下檔
[6] 上檔 [7] 榫口

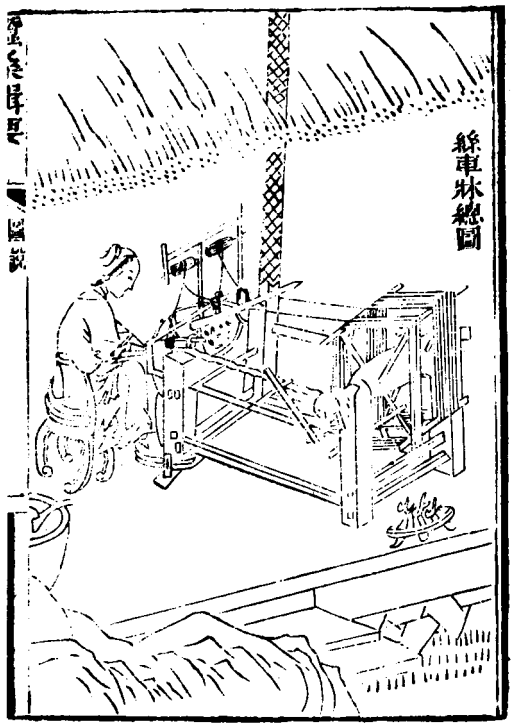


Fig. 237. Complete silk-reeling frame (*ssu-chhe-chhuang*), +1871. *Tshan Sang Chi Yao*, (*thu-shuo*), p. 2a.

open. The posts are some 65.6 cm high, about 9.6 cm broad and some 4.48 cm thick. The bearing has a width of some 3.2 cm and a depth of about 4.8 cm.

On top of the left front post a vertical tenon *(chih-sun[1])* is cut out which goes through the pulley *(mu-niang-tun[2])* (so as to act as its vertical axle). The post is some 66.56 cm high, about 8.96 cm broad and some 4.48 cm thick. The diameter of the tenon is about 2.88 cm, its circumference around 8.64 cm and its height some 5.44 cm. The height of the tenon is included in the height of the post.

The pulley (Fig. 239) is made of mulberry wood. Its top and bottom are flat with concave shaped sides. It has a height of about 6.4 cm and at its bottom a circumference of some 27.52 cm. The concave shaped sides have a circumference of about 22.4 cm. The shape of the body of the pulley is 8- or 10-sided polygonal. . .On the top (of the pulley) are two (upright) ears *(erh[3])*. Each of them has a hole going through horizontally. The height of the ears is some 2.56 cm. One small piece of wood acts as an 'eccentric lug' *(shuan*;* literally bolt). It is fastened horizontally in the upright ears and extends beyond the pulley. The length of the eccentric lug (also called *heng-liang-shuan[5])* is 16 to 18.2 cm, its width about 1.28 cm. On a length of some 9.6 cm or a little more, it perforates the holes of the two upright ears (on the pulley). (The eccentric lug) extends beyond the pulley by about 6.4 cm or a little more, having a width of some 2.56 cm. On the eccentric lug a vertical pin is fixed, the upper part of which is cut in a round shape so as to hold the ramping-board *(ssu-chheng[6];* literally silk-steelyard). The pin has a

[1] 直榫 [2] 牡孃墩 [3] 耳 [4] 閂 [5] 橫梁閂
[6] 絲秤

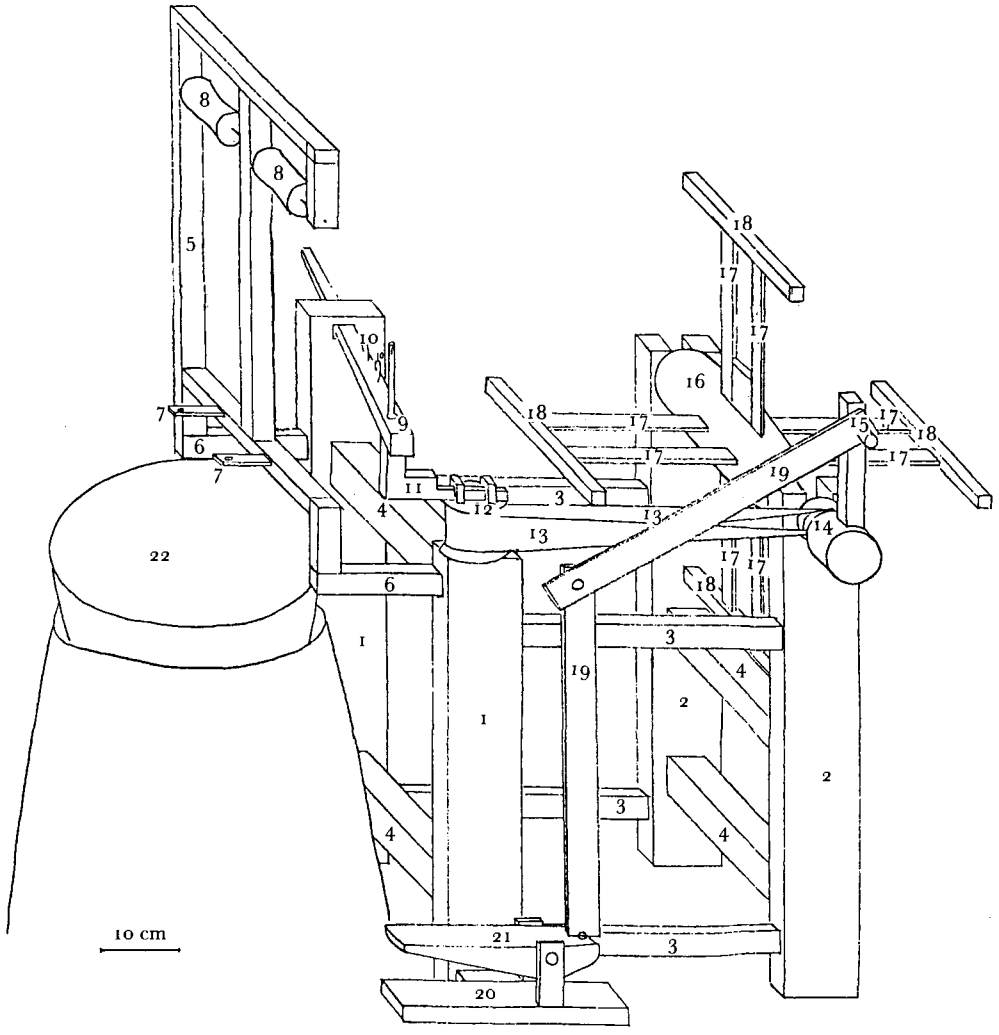


Fig. 238. Reconstruction of the complete treadle-operated silk-reeling frame, 19th century. 1, Front-posts (*chhien-chu*[1]). 2, Back-posts (*hou-chu*[2]). 3, Connecting-rods (*tang*[3]). 4, Cross-rails (*heng-tang*[4]). 5, Long post of the roller-frame (*phai-fang*[5]). 6, Short horizontal arms. 7, Guiding-eyes (*ssu-yen*[6]). 8, Roller (*hsiang-hsü*[7]). 9, Ramping-board (*ssu-chheng*[8]). 10, Guiding-hooks (*sung-ssu-kou*[9]). 11, Eccentric lug (*shuan*[10]). 12, Pulley (*mu-niang-tun*[11]). 13, Driving-belt (*huan-sheng*[12]). 14, Crank-case (*tuan-thung*[13]). 15, Crank (*chou-ping*[14]). 16, Silk-reel axle (*chhe-chou*[15]). 17, Spokes (*chiao*[16]). 18, Rails (*heng-liang*[17]). 19, Transmission shafts (*thiao*[18]). 20, Base-board (*tha-chiao ti-pan*[19]). 21, Treadle (*hsieh-pan*[20]). 22, Pan (*phen*[21]). The drawing is based on the *TSTP*, ch. 4.

[1] 前柱 [2] 後柱 [3] 檔 [4] 橫檔 [5] 牌坊
[6] 絲眼 [7] 響緒 [8] 絲秤 [9] 送絲鉤 [10] 門
[11] 牡孃墩 [12] 環繩 [13] 短筒 [14] 軸柄 [15] 車軸
[16] 腳 [17] 橫梁 [18] 條 [19] 踏腳底板 [20] 鞋板
[21] 盆

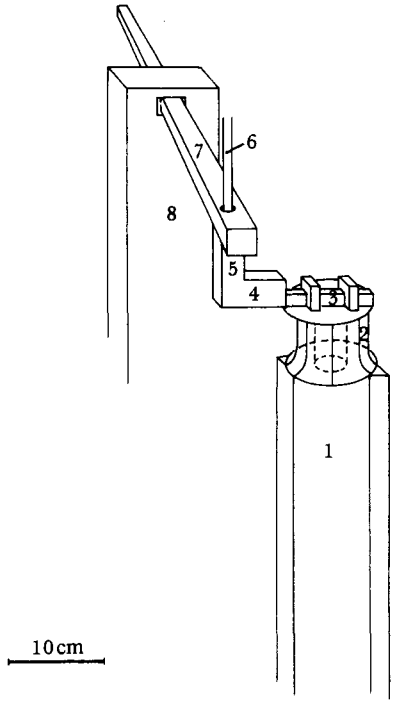


Fig. 239. Reconstruction of pulley, eccentric lug and ramping-board. (Detail of Fig. 238.) 1, Front-post (66.6/8.96/4.48). 2, Pulley (6.4); diameter (top and bottom, *c.* 9); diameter (octogonal concave shaped part *c.* 7). 3, Eccentric lug; part of the pulley (9/1.28). 4, Eccentric lug; extending beyond the pulley (6.4/2.56). 5, Upright pin (4.8/2.56). 6, Upper part of the upright pin (12.8). 7, Ramping-board (64/3.2/1.28). 8, Front-post (68.8/8.96/4.48) (in cm).

length of about 12.8 cm. Its lower part is cut square with a width of some 2.56 cm and a length of about 4.8 cm*

At the foot of (this) post, holes are cut to take thel-shaped tenons of the treadle-board *(tha-chiao ti-pan*[1]*)* (Fig. 240). The holes are near to the ground, having a width of about 2.4 cm and a depth of some 4.4 cm.[b]

To make the treadle base-board *(tha-chiao-pan*[2]*)* a piece of hard wood is used, some 28.8 cm long, about 9.6 cm wide and nearly 1.92 cm. thick. The tenons are cut in the shape of the character *kung* 'X' and they should be inserted in the left front-post of the framework in the previously prepared holes very close to the ground; the tenons of the

[a] This paragraph is translated from the *TSTP,* ch. 4, pp. iob-i ia, and added here because it fits in from its technical context.

* It is not possible to tell definitely to which part *'c.* 4.4 cm' refers. We have considered several possibilities but none seemed applicable, so we decided to understand the measurement as 'depth'.

[1] 踏腳底板 [2] 踏腳板

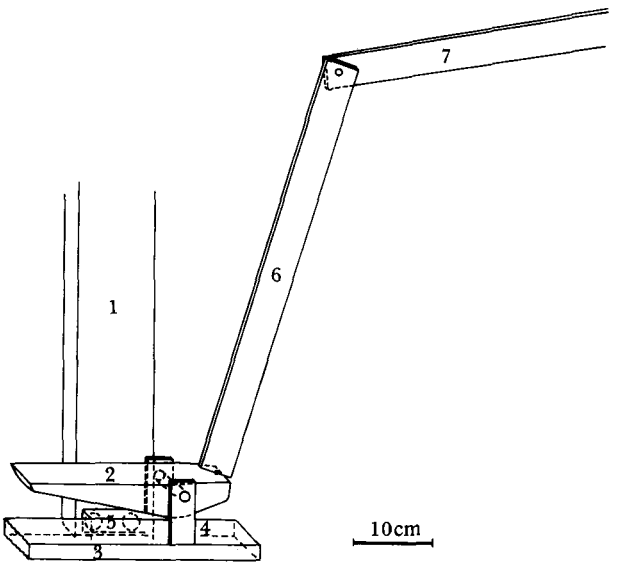


Fig. 240. Reconstruction of the treadle-mechanism. (Detail of Fig. 238.) 1, Front-post. 2, Treadle (25.6 (19.2+6.4)/0.96 → 4.48 → 1.92/6.4 → 8.32). 3, Base-board (28.8/9.6/1.92). 4, Ears (8). 5, I-shaped joining part. 6, Vertical transmission shaft (?/3.84/1.6). 7, Horizontal transmission shaft (?/3.84/0.96 (in cm).

base-board have a width of some 2.24 cm and a length of about 4.8 cm.[a] In this way the base-board is fixed tightly to the post. When the treadle is operated (this base-board) does not move at all. Two (upright) ears with a height of some 8 cm each and with a horizontally (drilled) hole going through in the upper part of the ears, are fixed (parallel) on the base-board. The width of the holes is about 1.28 cm and they are arranged at a distance of some 4.16 cm from the base-board. Again, another wooden board is used similar in shape to the 'sloping sole of a shoe' *(hsiieh hsieh-ti[1])* with a length of some 25.6 cm. The 'sloping' shape shows on the lower side. The front part of the lower side measures about 19.2 cm from the thin to the thick end, starting from some 0.96 cm increasing to some 4.48 cm; the back part measures about 6.4 cm from the thick end to the thin, starting from about 4.48 cm and reducing to some 1.92 cm. (If the treadle-system is arranged like this) it does not lose balance. If the lower part were flat, then the treadle *(hsieh-pan[2])* would have to be pointed when worked by the foot. Even if (the treadle) is lowered to the ground, it is not slanting; (hence) only a modest lifting and lowering (would take place) and that is all.[b] (Such an insufficient treadle-motion would result in the fact that) the vertical transmission shaft *(ckik-thiao)*[3] and the horizontal transmission shaft *(heng-thiao*)* (which join the treadle to the crank of the reel) would be

* So two of the four tenons of the *kung* I shaped joining piece are inserted in the baseboard. In this **way** the other two function as tenons of the baseboard when being inserted into the post.

» Most probably the author means that the balance of the treadle-mechanism is **not guaranteed, and results** in uneven motion.

[1] 削鞋底 [2] 鞋板 [3] 直條 [4] 橫條

unable (to cause) the continuous up and down motion of the silk-reel crank. Then also the silk-reel axle could not rotate as it should."

The front (part of the treadle) should be broad, the back (part) narrow, tapering from front to the rear. The broadest piece measures some 8.32 cm, the narrowest about 6.4 cm. The broad part is the foot-operated treadle. The narrow part (which is at the same time) the thick part, has a tenon on each side which goes through the holes of the ears of the base-board. The ends of these tenons should be round and not square. If they were square they could not move. The treadle (and its tenons) should be small (so that they fit loosely between) the holes (of the ears and in the ears themselves) and are not too tight, because otherwise the treadle cannot move.[13]

Apart (from the treadle-system) a vertical transmission shaft is used; (it has) a length of some 54.4 cm, a width of about 3.84 cm and a thickness of about 1.6 cm. One end is inserted into the thick part of the treadle (before the place where) the ears of the base-board are.[c] On the other end is a small hole.

Again, a piece of wood is used to make the (horizontal) transmission shaft which is some 54.4 cm long, about 3.84 cm wide and nearly 0.96 cm thick.[d] One end has a small hole like the vertical transmission shaft and so they can be joined to each other with a bamboo spike. The joint should not be too tight, otherwise the horizontal shaft cannot cause (the crank) to rotate. A round hole opens at the other end (of the horizontal shaft) through which the crank of the silk-reel axle goes horizontally. The hole is wider (in diameter) than (the diameter) of the crank.[e]

At the top of the right front-post a hole is horizontally cut to take the ramping-board. The height of the post measures some 68.80 cm, its width about 8.96 cm, its thickness some 4.48 cm. The width of the hole is about 3.2 cm, its height some 1.6 cm. To both front-posts small horizontal arms are fixed. They protrude towards the front. On the short horizontal arm of the left post a short upright stick is fixed. At its top a hole is cut into which the tenon of the bottom crossbar of the roller-frame *(phai-fang*[1]; literally 'honorific arch') is inserted on its left side. On the short horizontal arm of the right hand side there is no short upright stick, but at its end a hole is cut out which takes the right side (long post) of the roller-frame. The length of the short horizontal arm is about 16 cm, its width about 3.2 cm, its thickness some 3.2 cm. (Its distance) to the ground is about 51.2 cm. The height of the short upright stick is about 8 cm. Its width and thickness are the same as those of the horizontal arm...[f]

We may note that a system using transmission shafts to pass the motion of the treadle to the reel was quite common, especially in illustrations from Ming times onwards. But instead of wooden shafts strings, made of hemp, could also be employed.

[a] This paragraph is translated from *TSTP*, ch. 4, pp. i3ab. " *Ibid.*, pp. I3b-i4a.

[c] The Chinese text says: 'between the ears'. But this is certainly wrong, because such an arrangement would not produce a lifting and lowering motion.

[d] The length of the transmission shaft, given as *c.* 54.4 cm, is certainly an error. When reconstructing the machine in drawings to scale *(c.* 1:5 (cm)), transmission shafts of this length could not be made to fit. So we have corrected their lengths and shortened them to *c.* 47 cm.

[e] The previous two paragraphs are from *TSTP*, ch. 4, p. 14a.

' *TSTP*, ch. 4, pp. I5b-i6a; the text continues but does not contain any new information with regard to the reconstruction of this type of silk-reeling frame.

[1] 牌坊

To obtain all the data on the machine essential for a complete reconstruction (Fig. 238), we now have to consider the variety of roller-frames. Then we can select the necessary paragraphs on the reel.

Two types of roller-frames are described. First, the more widespread and better known 'roller-frame with double guiding-eyes' *(shuang-ssu-yen phai-fang*[1]*)* which, as its name indicates, has two parallel guiding-eyes fixed to the bottom crossbar of the frame and stretching a short distance over the reeling-pan. Secondly, we hear of the 'roller-frame with three guiding-eyes' *{san-ssu-yen phai-fang*[2]*)* which needed a more elaborate framework. A roller-frame with three guiding-eyes *(tso-ssu-yen*[3]*)* needed two long and two short posts or arms, and three rollers. The vertical posts could have been arranged in various ways, with either the short hanging arms at the sides and the two posts in the centre or *vice versa. A* detailed description of this obviously rarely used roller-frame is not given in the text. The frame with two rollers certainly constituted the most important type of the advanced systems. Its framework consisted of several parts: a top crossbar with a length of some 49.60 cm, a bottom crossbar with a length of about 44.16 cm, a long post which measured some 50.56 cm into which both crossbars fitted on the right-hand side. The middle post of the frame had a length of about 43.20 cm. The two rollers were arranged on both sides of it. A short hanging arm served as the bearing of the roller-axle. It had a length of some 8 cm, and corresponded to the short upright stick which held the bottom crossbar on the same left-hand side.[8.] The axle was made of fine bamboo splints *(hsi-mieh*)* or iron wire *(thieh-ssu*[5]*)* and perforated the roller *(hsiang-hsii*[6]*).* The rollers were made of bamboo, some 12.8 cm long and measuring about 12.8 cm in circumference, giving a diameter of some 4.3 cm. In the middle between the knots *(chiebP,* the septa of the bamboo) are lines *(thiao-lii*[s]*)* carved out to guide the silk threads.

Two holes at a distance of about 14.4 cm from each other were cut out of the front of the bottom crossbar. They accepted the rectangular shaped wooden pieces, called guiding-eyes, each some 7.68 cm long and between about 2 cm and 2.25 cm broad. The eyes themselves were small openings, often resembling a Chinese coin.

The silk-reeler who was learning to do the job used a single guiding-eye *{tan-yen*[9]*);* the one who had mastered reeling used two guiding-eyes *(shuang-yen*[10]*),* while the most experienced reelers may have worked with three. The fineness or coarseness of the silk depended on the number of cocoons in the pan. If one reeled off many cocoons parallel, then the silk became coarse in quality; if only a few were reeled off, the silk threads were fine. The quality did not depend on the number of guiding-eyes employed.

[a] Paraphrased from the text of the *TSTP,* ch. 4, pp. 8b-ga.

[1] 雙絲眼牌坊 [2] 三絲眼牌坊 [3] 做絲眼 [4] 細篾 [5] 鐵絲
[6] 響緒 [7] 節 [8] 條縷 [9] 單眼 [10] 雙眼

Having now dealt with the rollers and guiding-eyes we return to paraphrasing the paragraphs on the ramping-board and the silk-reel.[a]

The ramping-board *(ssu-ckheng)* had as many hooks *(sung-ssu-kou)* as there were guiding-eyes and rollers. In the Chhing period a popular name for the ramping-board was 'pull-up lance' *(chhou-chhiang[1])*. The ramping-board measured about 64 cm in length, its width at its head was some 3.2 cm, at its tail about 1.28 cm. It tapered from head to tail. A hole was drilled in its head through which the vertical pin of the eccentric lug passed. The tail of the ramping-board went through a hole in the right front-post, but left enough space so as to be movable. The guiding-hooks fixed on the ramping-board were originally made of bent bamboo, but by Chhing times corkscrew shaped copper or iron nails were used.

The hooks of the ramping-board guided the silk threads from the rollers to the reel. Because of its oscillating motion the threads were laid down in regular layers as expected in an industrial product. The silk skeins produced in this way were easy to take off the reel without the danger of becoming tangled.

The silk-reel axle *(chhe-chou[2])* was made of hardwood. Its right end was placed in a hole drilled through the right-hand back-post. This hole acted as a bearing for one end of the axle, but the situation on the left-hand side was more complex. Here there was not only a tenon at the right-hand end of the axle, but an extension of the axle was joined to this tenon which acted not only as a pulley, but also as a crank. Let us go into details (Fig. 241).

The axle had a length of some 41.6 cm, a circumference in the middle of about 28.8 cm which gave a diameter of roughly 9.6 cm, tapering towards the ends to about 25.6 cm. The tenons had a length of some 4.8 cm and a diameter of about 3.2 cm. The 'extension duct' *(tuan-thung[3]*, literally a short tube),[b] the essential part for transmitting motion from the foot-operated treadle to the silk-reel and, at the same time, to the pulley of the eccentric lug operating the ramping-board, had a length of about 11.52 cm, and a circumference of some 22.4 cm which roughly corresponds to a diameter of about 7.3 cm. A piece some 4 cm long and near the tenon, was thus close to the back-post, and was wasp-waisted *(feng-yao**)*. It had a diameter of roughly 5.9 cm. It functioned as a pulley, transmitting motion from here to the ramping-board with the aid of a driving-belt which connected with the pulley on the front-post. To guarantee continuous, uninterrupted motion of the driving-belt, the wasp-waisted pulley had an indentation some 1.6 cm deep.

In the middle of the remaining 7.4 cm or so, a hole was cut out through which an upright piece of wood was inserted. It had a length of about 16 cm, a width of roughly 3.2 cm and a thickness of some 3.2 cm. Between 1.6 and 1.9 cm from its top, a horizontal handle *(chou-ping[s])* was inserted. This had a length of some 6.7 cm. Although there is no mention of how the horizontal transmission shaft was

» *TSTP*, ch. 4, p. 10a.

[6] It is not clear to us why this piece was named *thung*, which normally means something which is hollow inside—a pipe, for example.

[1] 抽鎗 [2] 車軸 [3] 短筒 [4] 蜂腰 [5] 軸柄

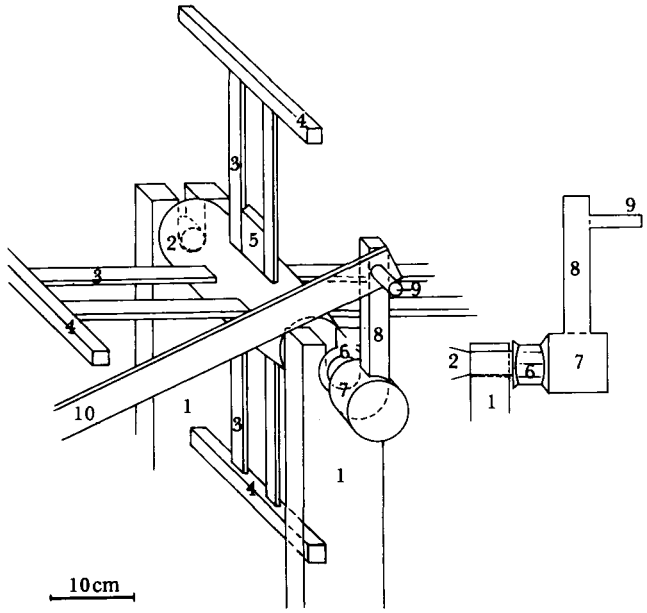


Fig. 241. Reconstruction of the silk-reel. (Detail of Fig. 238.) 1, Back-posts (65.6/9.6/4.48); bearing of the axle (⊢3.2/⌶4.8). 2, Axle (41.6/0.85→⊗c. 9.6→⊗c. 8.5); tenon (4.8/⍉3.2). 3, Spokes (20.8/3.8/2.6). 4, Rails (40.32/3.8/3.8). 5, Wedge (16/7.04→3.8/2.6→2.3). 6, Pulley (4.1/⊗c. 5.9/indentation 1.6). 7, Extension duct (7.36/⊗7.3). 8, Upright piece (16/3.2/3.2). 9, Handle (6.7). 10, Horizontal transmission shaft (in cm).

fixed to the handle, we may assume either that a bolt must have been used or at least a piece of wood like it.

A four-sided reel (Fig. 241) had four pairs of spokes *(chiao)* which were inserted in the body of the axle. The length of each spoke measured some 20.8 cm, the tenon not included. Its width was roughly 3.8 cm, its thickness about 2.6 cm. Two spokes were always inserted into one rail *(heng-liang*[1]*)* which had a length of some 40.32 cm, a width and thickness of about 3.8 cm. Three of the four pairs of spokes were fixed tightly, and only one pair was inserted so as to be movable if required. This was achieved by a horizontal groove some 13.44 [cm] l[o][n]g) [a] width of about 2.6 cm on the obverse side and with a length of some 12.16 cm and a width of nearly 2.3 cm on the reverse side. When the movable spokes were inserted into the groove, a wedge *(thing-mu*[2]*)* was knocked in the intermediate space to fix them. The wedge had a length of about 16 cm, a width of nearly 7.04 cm and a thickness of some 2.6 cm at its broad end. At its narrow end corresponding measurements were reduced to some 3.8 cm and about 2.3 cm. Hammering in the wedge, the spokes were set in very tight, but easing it out allowed the spokes to be taken off. This sort of fitting had already been pictured in the *Thien Kung Khai Wu* (Fig. 236).

[1] 橫梁 [2] 杅木

Where the spokes were inserted into the rails, cloth was used to cover the rails on all four sides. This was called 'dress of the reel' *(chhe-i[1])*.

This type of silk-reeling frame could probably be found in all sericultural regions of China in late Ming and Chhing times. As far as we know, the complete silk-reeling ' machine ' considerably facilitated the reeling of silk, making the work faster and thus increasing the daily output which, in the 19th century amounted to some 600 to 1,000 g per reel, worked by one operator.* Of course the output depended on the number of the cocoons in the pan which were reeled simultaneously. So the efficiency of domestic silk-reelers of the late Chhing compares rather well with the daily output of factory silk-reelers, using steam-powered silk-reels, and producing some 410 to 450 g daily.[b] Indeed, Lillian M. Li arrives at the result that mechanised reeling neither enabled better yields of silk to be obtained from the cocoons nor that the steam-reeling resulted in any labour or cost saving; the only advantage of factory reeling by western machinery consisted in the absolute uniformity and reliability of the raw silk produced. Such standards, which were demanded by the western buyers of silk, could not be achieved by domestic rural silk-reeling methods.[0]

We can confirm the results Lillian M. Li arrived at for the late 19th and early 20th centuries. Today the daily output per operator on Chinese machinery produced in the 1960s and designed in accordance with Japanese reeling machines, is considerably higher than half a century ago. Taking into account the workforce employed for all the preparatory work prior to reeling and the staff needed to administer the workforce and the products, the daily output per person working in the factory diminishes to about 700 g of raw silk, which appears a rather low economic efficiency considering the high division of labour practised.* But in the 19th century, European and American buyers and consumers were willing to pay considerably higher prices for factory reeled silk.[e]

What was the difference between European and Chinese silk-reels apart from the driving-power? Why was the factory reeled silk of absolute uniformity? To answer these questions we have again to resume discussion on methods of crossing-over in the reeling process. As has been pointed out, as early as Sung times the Chinese tried to solve the cross-over problem but did not succeed in making the 'complete winding' method economically attractive. So they used the double

[a] Li (1), pp. 29-30; *SILK*, p. 57 says 20-30 taels a day by an experienced hand on the complete silk-reeling frame, pictured in Fig. 236; the *KTSSCP*, ch. 2, p. 26a gives 1 *chin* as daily output which is *c.* 600 g.

[b] Li (1), p. 30, n. 87; very often even a lower figure is given, see Yüeh Ssu-Ping *(1)*, p. 102; Anon. (607), p. 16 says 9-11 *Hang* per day. The daily output in Europe on the same types of machines did not even reach 400 g but only 200 g, see Silbermann (i), vol. 1, p. 363.

[c] Li (1), p. 30.

4 The figure is based on calculations we made in Silk-reeling Factory No. 2 at Wu-hsi in Kiangsu (*Wu-hsi-shih sao-ssu ti-erh-chhang*[2]). In September 1979 the factory had a staff of 1482 persons; the yearly output in raw silk amounted to 300 tons. Figuring 300 working-days a year, we arrive at the result of *c.* 700 g per person per day.

[e] Li, pp. 30, 82, table 14: Prices of white raw silk at Shanghai from + 1862 to 1931.

[1] 車衣 [2] 無錫市繅絲第二廠

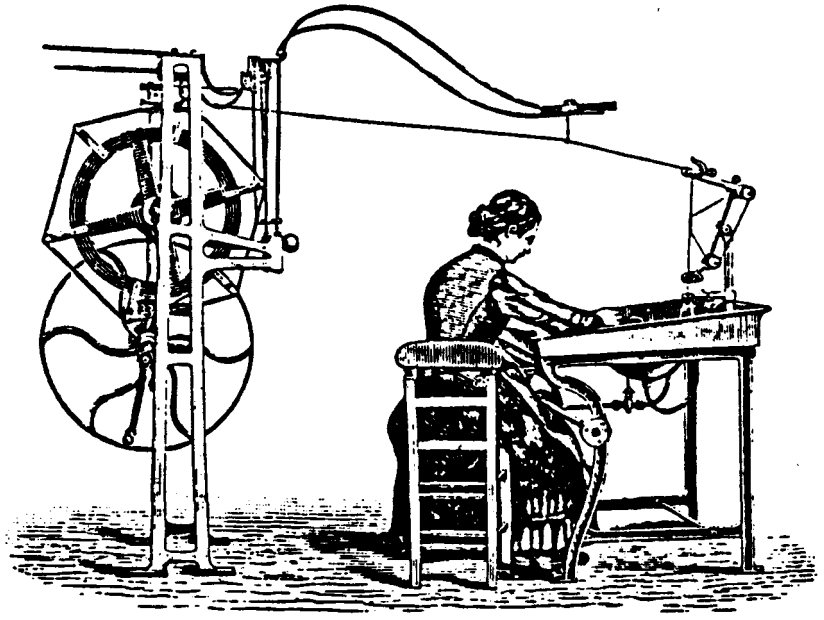
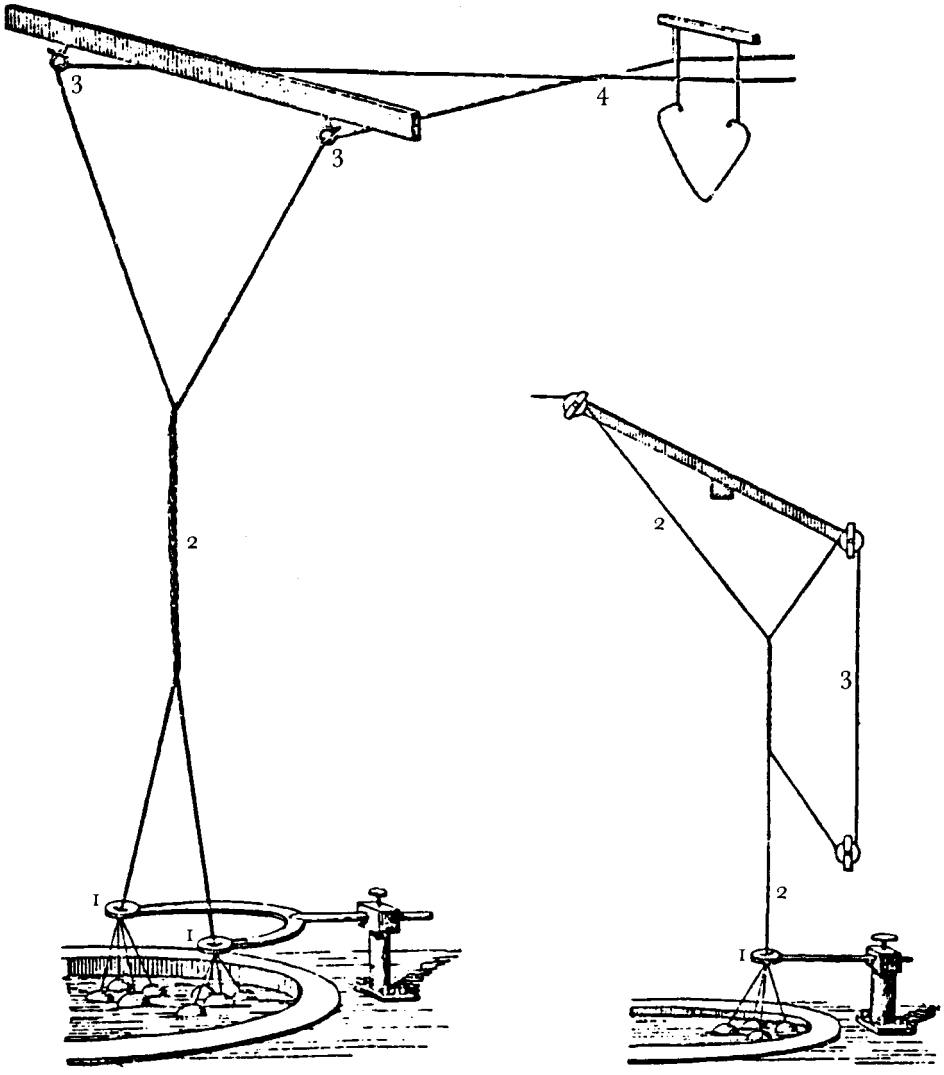


Fig. 242. Italian steam-powered silk-reeling machine, 19th century. Silbermann (1), vol. 1, p. 363, fig. 206.

winding and single winding techniques, both of which secured economic efficiency at the cost of quality. The various qualities of raw silk they obtained could afterwards be graded according to the types of weaves for which they should be used. The situation in the European industrialised weaving factories differed fundamentally: standardised qualities of raw silk were needed to produce fabrics of a uniform standard and on a large scale. And it is here that the European silk-reeling came into its own: it offered methods of crossing-over which reeled silk uniformly.* The two systems the Europeans introduced into China, both in the late 19th century, were the Italian à la Tavelle which was established in Shanghai (Fig. 242) and the French à la Chambon in Canton.[b] The significant difference between these systems and those of the Chinese did not lie in the number of ends which were reeled parallel,[0] but in the way the crossing was performed so as to squeeze off the water and make the silk thread round and even. À la Chambon was a self-crossing system in which the two silk threads which were reeled off parallel, crossed twice around themselves (Fig. 243.1). The crossing always occurred at the same place. But the system had disadvantages. In practice, the crossing could drift to the left or right depending on the strength of the threads, and, furthermore,

[s] *GTL*, vol. 2, pp. 363-4.
[b] Li (1), p. 29; Silbermann (i), vol. I, pp. 362-9.
[c] Li (1), p. 29 says: '... .the "French" or Chambon type was used, even though it was considered inferior because only two ends could be reeled at one time.' In our opinion it was not inferior, but probably the best system available at the time; see Fig. 243.1.



1. Crossing à la Chambon
   1. Guiding-eyes
   2. First crossing
   3. Guiding-hooks
   4. Second crossing

2. Crossing à la Tavelle
   1. Guiding-eye
   2. Silk thread
   3. Crossing-string

Fig. 243. The French and Italian crossing-systems, 19th century. Silbermann (1), vol. I, p. 364, figs. 207–8.

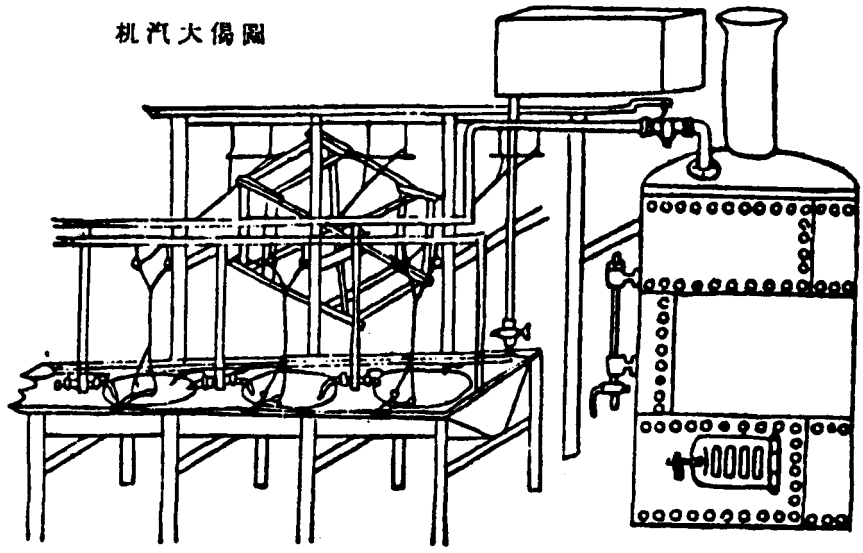


Fig. 244. Fast-reeling steam-powered silk-reeling machine (*chi-chhi ta-chieh*), Canton, + 1872. Pheng Tse-I (1) vol. I, p. 19.

it was a type of crossing which resulted in a strong tension that could easily cause breaks, and thus reduce the quality of the silk thread produced. The Italian method (Fig. 243.2) used a simpler method of crossing. The silk thread was wound round a movable loop-shaped string. This was certainly the most elegant and most effective method of reeling silk thread of standardised quality but not the most economic. An incomplete and non-working model of a steam-powered silk-reeling machine of the French type as it may have been used in + 1872 in Canton was on display in 1979 in the *Kuang-chou po-wu-kuarP* (Fig. 244).

The first primitive silk-reeling device in the Shang workshops was a far cry from the hand-driven silk-reels yielding a daily output of less than 200 g, but it was even further to the treadle-operated silk-reeling frame with all its various winding systems that made possible a division of labour in the reeling process to increase the daily production rate to some 1400 g per'machine'. It was further still to the complete silk-reeling frame, worked by one operator but with a daily output of 600 to 1000 g of raw silk. The sources show us that silk-reeling as a job was a seasonal activity of silkworm breeders in rural areas. Only with the introduction of western techniques and technology in the 19th century, did silk filatures, organised as factories, start to reel silk to industrial standards.

The rural silkworm breeders, who depended on the success of their silkworm crops, were constantly threatened by the fear of an outbreak of some silkworm disease; they also lived permanently uncertain about the market price for silk when reeling had ended. Yet they still enjoyed the job they were doing, watching

» See the illustration in Pheng Tse-I *(i),* vol. I, p. 19: source, *Tshan Sang Phu* (+1873).

the silkworms growing, making their sleeps, and spinning the cocoons.[8.] They believed in a superstitious system which taught that silkworms liked cleanliness, warmth and dryness and hated meat as well as dirt, noise, shouting, mourning and pregnant women, and they saw to it that these conditions were met.[b] The opening of the silkworm season in spring always started with a festivity, and thus maintained an important place in the annual rural cycle. Silk-reeling finished the year's sericultural season, and all members of the family could then see the results of their combined efforts.

The industrialisation of silk-reeling in filatures at the end of the 19th century and particularly in the first half of the 20th century considerably changed working conditions of the silk reeler, at least in the big cities and the main centres of silk production. These conditions were almost beyond imagination, with long working days for children and adults in a dirty and steamy hot atmosphere.[0] Eleanor M. Hinder reports:*'Tiny children stood for an eleven-hour day, soaked to the skin in a steamy atmosphere hot even in winter, their fingers blanched to the knuckles and their little bodies swaying from one tired foot to the other, kept at their task by a firm overseer who did not hesitate to beat those whose attention wandered.'

After the People's Republic of China was founded, such working conditions, which could be found throughout the country in all branches of the textile industry, were abolished as fast as circumstances allowed. The time when the industrialisation of Chinese textile manufacture started and spinning, weaving and silk-reeling factories sprang up like mushrooms has passed long ago.

Further on we shall make a fuller comparison between silk-reeling machinery in China and in Europe, but before doing so and in order to retain a proper historical sequence in describing the production of silk thread in China, we must discuss a kind of twisting-frame used in warping. We have already taken note about those working steps such as quilling, for example, which had to be performed after reeling to produce weft silk threads. Now we must look at the more complicated devices used for warp-threads. Only after this can we consider silk machinery as a whole, and compare the types used in China and Europe, and reveal similarities between them.

(6) THE MULTIPLE SPINDLE TWISTING-FRAME FOR WARP-TWISTING

Although our 19th century illustrations clearly depict multiple spindle doubling-frames" for warp-threads, there is one specific reason why we rather prefer in this context to talk about the multiple spindle twisting-frame. The earliest reference to the frame of + 1313 says :[1]

[a] See Mao Tun (1), pp. 1-26.
» *SILK*, p. 126; *KTSSCP*, ch. 2, p. 47b; Sun (3), p. 38; *TSCMCS*, pp. I7ab; Li (1), pp. 22-3.
[c] Li (1), pp. 173-5; ^ng (1); Yiieh Ssu-Ping (/), pp. ioi, 107-9, 9^-
[a] Hinder (1), p. 35. [e] *TSTP*, ch. 11, pp. 40ab, 42ab. ' *NS*, ch. 22, p. 8a.

A recently set up silk-spinning frame *(ssu-hsienfang-chhe*[1]*)* differs only in details from the (multiple spinning-frame for ramie as mentioned) above...

The passage says 'spinning-frame' but silk could not be spun on it; 'spinning' has to be understood as twisting, putting a spiral into the thread. There is no way to ascertain whether single threads were twisted or doubled (that is whether two single warp-threads were twisted into one in a single operation), or whether they were thrown (when three or more single threads were similarly twisted). In any case, the invention of multiple spindle twisting preceded the more complex doubling technique. The discussion which follows will hold for both, but in order to make for easier reading and to avoid repetition, the phrase 'twisting-frame' will be taken to stand also for the doubling-frame, until we reach the 19th century. Then we shall be in a position to analyse the specific doubling-frame produced during that century.

The passage quoted clearly indicates that a silk-twisting frame had been used in Yuan times and probably, one may conclude, had already been developed during the Sung. The major problem we face is that there exists no other original text about the frame to confirm its existence between +1313 and +1899. Furthermore, the multiple spindle silk-twisting frame, equipped with spindles, can only in part be compared with the multiple ramie-spinning frame with its cylindrical boxes to hold the thread. Yet they do have some structural features, such as the reel, driving-belt and driving-wheel in common.

But before starting to produce a hypothesis explaining the lack of new information in the sources—and more cannot be done at present—we must outline the use of warp-thread twisting and the devices employed to perform this task.

The twist which is put into the silk thread in the reeling process is not sufficient for a thread to be used as warp on a loom; it cannot stand the permanent tension which it receives during the weaving process and will break. Such breakages of the warp mean tedious and time-consuming mending and result in a reduction in quality of the silk fabric. To prevent it falling into its individual filaments during weaving, warp-threads need a tight twist. Therefore the singly twisted threads are taken together after spooling and twisted in the opposite direction; then they must be doubled and thrown, so as to give them added tensile strength and elasticity, both fundamental qualities for warp-threads.

We have already seen that when used for quilling, the effective spindle-wheel was employed to perform this necessary task for weft-threads. It seems highly likely that warp-threads were also twisted on it, though there is no written reference confirming this assumption. Probably it was always taken for granted. We may assume so because—to our knowledge—no other type of warp twisting device geared solely to the production of warp-threads existed before Sung times. Twisting silk threads on a special device also meant producing threads of standard

[1] 絲線紡車

quality. But quality constituted only one factor, the other was the quantity of thread required for warp and weft. In the *Thien Kung Khai Wu* we read:[a]

> After spooling, the silk threads are made into warp and weft-threads. The warp-thread consumes less silk than the weft-thread, the general proportions being four-tenths for the warp and six-tenths for the weft.. .

The author states that 60 % of the silk threads spooled went into the weft. So it appears obvious that the preparation of weft-threads, for which the Chinese used the traditional device designed for quilling and doubling and, on a smaller scale also employed for the twisting of warp-threads, attracted the attention of Chinese scholars when carrying out research on textile machinery. For this reason, the spindle-wheel and all its various functions are well documented.

With regard to the multiple spindle silk-twisting frame two presuppositions should be kept in mind. First, unskilled labour at low cost was always available in rural areas of China, a fundamental factor for the processing of the material and for the cheap production of textiles. Secondly, compared with the silk-reeling frame, the spindle-wheel appears to be a rather simple device, easily built and operated. Hence in the spinning process as a whole, there was generally no need to improve the devices known in Sung and Yuan times so as to make them labour and time-saving. This was not the case in the reeling business, which was based on the life-cycle of the silkworm. So the question arises why the 'rural people' of China developed the multiple spindle twisting-frame, a 'machine' difficult to construct, which required specialists, and constituted a considerable financial outlay.

When discussing the multiple spinning-frame for ramie which was employed in the + 13th century in the Central Plain of north China, we have already noted that it produced the same amount of twisted thread per day as some 30 spindle-wheels operated for 24 hours. But setting up a multiple spindle silk-twisting frame was certainly equally effective and saved a lot of money which would otherwise have had to be spent on the manufacture of spindle-wheels. And there is another reason which seems to be still more important; setting up and operating such a frame demanded common sense and general interest among the whole community in a village, or more probably in a whole district. Only when the frame twisted silk threads for most of the year was its economic effectiveness guaranteed. Therefore we have to look for some stabilising factor which encouraged people to pool their raw silk to get it twisted on the frame. It may have been comparable with ramie twisting 'when all households have much material to be twisted, then they come together at the driving-wheel. They weigh the material and share (the output of) thread (according to individual input).' Yet there was certainly a substantial difference between the twisting of ramie and silk; spun ramie served to cover the needs of farmers, and only a small amount was sold; silk on the other

[a] **Sun (1), p. 50.**

hand had to meet certain standards so as to be suitable for tax in kind and to be bartered or sold.

Generally silkworm breeders produced the raw silk sold to merchants (warehouse proprietors, brokers, contractors) or on the local markets. The merchants again sold the material to rural and urban households with looms.[8.] In +nth century during the Sung, weaving workshops undertook some preparation of the thread for weaving. This possibly included twisting, as is documented for the government-run *Chin-yuan*[1] in the *Shu Chin Phu* where we read of eleven spinners in charge of the work.[b] At the beginning of the Ming (+ 1371 to + 1372) the Weaving and Dyeing Mill *(Chih-jan-chü*[1]*)* of Ning-kuo-fu in Anhui province employed 98 people spooling silk, of whom 15 made thread and 9 quilled weft-threads.[0] In +1528 the Peking workshop employed 62 people spooling silk.[d] There is no information about warp-twisting, confirming that it was part of the work done by employees in the workshops. In Chhing times silk firms specialised in warp-threads, the warp-thread companies *(ching-hang*[3]*)*.[e]

In the case of the multiple spindle silk-twisting frame, the system may have worked differently. Twisting did not take place in the weaving shops but in workshops specialised in warp-threads, though this may have been a peculiarity of the region around western Shantung and Honan. Local silk brokers could have run such workshops, buying raw silk from the silk breeders, processing it into warp-threads and selling them, graded into various qualities, to the weaving workshops. Whether the owners of the twisting-frames were farmers, landlords or merchants cannot be ascertained. But it appears unlikely, considering general conditions in the silk trade, that the frame was set up and operated by the farmers themselves, so the local silk brokers should be regarded as the stabilising factor in the rural silk economy. They sold the thread to the weaving workshops—prepaid or cash on delivery—in the quality required to dress their looms for the various fabrics to be woven. Thus they not only played a part in the processing of silk but also acted as silk merchants, financing the production of the silk itself. The weaving workshops belonged either to rich landlords residing nearby, or to the government, or were households having their own looms.

In the + 13th and early + 14th centuries the multiple spindle silk-twisting frame could be found in many villages on the Central Plain, as we may deduce from information provided in the *Nung Shu.* But as Wang Chen was a native of Shantung, he always preferred northern techniques and devices to southern. In

» Shiba (1), p. 121.

[b] *Shu Chin Phu,* p. 247.

[c] *Ning-Kuo-Fu Chih,* ch. 12 *' ïii-ti-chih', ku-chi*, shang.*

[d] *Ta Ming Hui Tien,* ch. 189 *(kung-pu*[5]*),* 9, p. 2583. Many more spoolers are mentioned in the chapter.

[e] Shih Min-Hsiung (/), pp. 45, 59; Sun (3), pp. 23-5. In Chhing times it happened that **all** sorts of works connected with silk were executed in weaving workshops, Shih Min-Hsiung (7), p. 76. Generally we may say that reeling was done in filatures and twisting in spinning mills. Even nowadays in **workshops** with hand-operated draw-looms, the silk thread preparation is performedl in the weaving **workshop. One** of us observed this in autumn 1979 in Chheng-tu and Nanking.

[1] 錦院 [2] 織染局 [3] 經行 [4] 古迹 [5] 工部

consequence we may rightly assume—by analogy with the silk-reeling frame—that technology transfer from north to south-east and west China which occurred on a large scale in the + 12th century, brought this twisting-frame into Kiangsu-Chekiang and Szechwan, where it underwent distinct regional improvements based on local traditions.[8.] So the frame surely was operated in + 14th century Yuan and Ming times not only in north China but also in other areas, though probably in small numbers.

From then on until the 19th century its existence cannot be proven; we have been unable to trace a single new, original text or a pictorial reference to it in Ming times or in + 17th and + 18th centuries Chhing times.[b] That the multiple spindle silk-twisting frame completely disappeared in Ming times appears rather unlikely for two reasons. First of all, once a device is established, and widely known and used, it has always survived in one region or another,[0] maintained by tradition in performing its daily work; second, no such frames could have appeared in 19th century China without a manufacturing and working tradition which had been handed down from generation to generation.

From the lack of new material, we must conclude that in all probability the number of frames had rapidly decreased in Ming times and that not one frame was kept at work in the main centres of silk production. The few frames which still operated belonged to workshops in remote areas, due to the fact that people in such areas tend to retain the old traditions. Hence the authors of agricultural and encyclopaedic works of the time quoted the text from the *Nung Shu* and included the illustration of the multiple spinning-frame for ramie, but did not provide new descriptions or better illustrations based on their own knowledge and experience. In the case of the multiple spindle silk-twisting frame mentioned in the *Nung Shu* in one sentence only, enough room was left for subsequent scholars to supplement the details. Evidently the long-cherished Chinese tradition of textual and pictorial transmission ignored a living tradition which had to be traced and could not be found on the doorstep.

So far we have considered both the facts and the lack of evidence in trying to trace the history of the multiple spindle silk-twisting frame from Sung to Chhing times. Now we should consider what may have been the reasons for its fall into disuse in Ming times. Although we can draw attention to a large number of papers on Ming and Chhing textile economy,[4] most changes in manufacturing techniques happened unnoticed or received only superficial attention. Apart from cotton technology—which attracts historians because of its impact on the industrial revolution in Europe—and the introduction of western technology into

[a] In the 19th century the Kiangsu-Chekiang type and the Szechwan type existed; both are discussed below. [b] Li Chhung-Chou (*2*), p. 29.

[c] See above, ch. (*d*), (5), a multiple spinning-frame, similar to the one described in the *Nung Shu* is still operating in Chekiang.

[d] Pheng Tse-I (*3*), pp. 33–56; (*2*), pp. 91–116; (*4*), pp. 63–73; Saeki Yuichi (*4*), pp. 77–108; (*3*), pp. 611–35; (*1*), pp. 167–210; (*2*), pp. 359–425.

China at the end of the 19th century, there is no study in which changes of textile techniques have been tackled in the broader context of economic and demographic conditions.

In Sung times, especially in the Southern Sung, every effort had to be made to feed some 100 to 120 million people living in the southern provinces[8,] in an area which was rather small compared with that occupied during the Thang and Yuan dynasties. It was also limited in the north by the 'barbarian' frontier and the sea to the east and south. Due to the high cost of maintaining an inflated army and to the tribute payments to uphold a shaky peace on the northern border, the peasants were subject to heavy tax burdens, and scarcity of arable land made it extremely difficult for them to keep their independence. The emergence of a distinct culturally, politically and economically powerful scholar-official class, necessarily produced new conceptions of life. This was especially so, since the class also included rich landowners, the educated *nouveaux riches* as well as merchants pursuing their own interests. Indeed people of all these groups held positions and managed affairs which required political and financial flexibility at a level never known before. So both internal and external reasons led to technical innovations and improvements of high efficiency so as to improve living conditions. They also led to scientific discoveries without parallel in the later history of China.

Compared with Northern Sung times, the area controlled by the Ming dynasty—about 4.4 million square kilometers in + 1580—had increased. The Ming also faced difficulties with their 'barbarian' neighbours in the north, particularly in the first half of the +I5th century and in the middle of the + 16th, and these culminated in the siege of Peking in + 1550. But generally their military campaigns and their foreign policy, which consisted to a considerable extent in passivity, proved to be more successful than those of the Sung, at least until the early decades of the + 17th century.

The authority and shrewdness of the early emperors with their absolute power guaranteed a high degree of stability in the interior, laid a solid foundation for the cultivation of traditional values which were held in high esteem after Mongol rule, and gradually favoured a spirit of neo-Confucianist restoration. Their policy brought a new prosperity after the chaotic and disastrous decades towards and around the middle of the + 14th century. (And severe these earlier times had been. Apart from local uprisings there were also pirate raids and the fight against the Mongols.* In addition, the Yellow River also changed its course in + 1324 and + 1336, and in +1327 and +1344 burst its dikes and flooded the countryside. What is more, regional famines broke out in + 1342, + 1345, + 1347, and + 1354, while epidemics are reported from + 1352 to + 1354.[0] All these events resulted in peasant uprisings in +1346, +1351 and +1352.) Chu Yüan-Chang[1], first

[a] Franke and Staiger (1), p. 134.
*> Gernet (4), pp. 354-8, 329-30.
[c] *Ibid.*, pp. 616-17.

[1] 朱元璋

emperor of the Ming dynasty, who chose Hung-wu' as his reigning title (+ 1351 to +1398), set out to reorganise a working agricultural system and rebuild an attitude which favoured artisans and craftsmen as the Mongols had done. These classes were grouped into two categories; the *chu-tso*[2] families, working in government workshops and subject to the Ministry of Public Works, and the *lun-pan*[3] who had to work a certain number of days every year in those workshops. And during this reign period the professions of artisan and craftsman, peasant and soldier were hereditary within the family, passed down from one generation to the other. We may say, then, that the economic conditions generally appeared favourable to the employment and development of advanced machinery ,[a] though there is no evidence of new inventions in the field of the textile machinery discussed in this study.

Now we can resume the problem of the multiple spindle silk-twisting frame in the Ming and Chhing. In our opinion, three reasons may be advanced to substantiate our assumption that this type of frame almost fell into complete disuse after Yuan times.[b] One was the gradual impoverishment of smallholders from the beginning of the + 15th century, due to constant pressure exerted on them by the powerful landowning gentry, which escaped the control of the central government.[0] A second was the increase in the population living mainly in rural areas from some 60 to 65 million people in + 1393[d] to no less than about 170 million in + 1745 ; a figure which increased to 358 million in + 1811 .[e] The third reason was economic change from commerce in kind at the end of the + 14th century, to other forms of trade. In the + 15th century inland commerce became based on silver ingots, and in the following century there was the newly created 'single-whip' tax system based on silver, both of which fit in with the notion of 'sprouts of capitalism'.'

During the Sung, devices for the manufacture of silk were geared to economic effectiveness due to conditions in Sung society and to the state finances. In Ming times, the sudden increase in population by more than 100 per cent within something like 150 years caused a considerable surplus of labour. Furthermore, the price of silk always depended on the market which was solely dictated by supply and demand. Quite apart from natural disasters which could destroy a whole season's crop, all silkworm breeders ran a high risk of loosing money when bartering or selling raw silk for silver to pay their taxes, because of fluctuations in the price of silk and the value of silver. Impoverished peasant households with many mouths to feed who were rearing silkworms as a sideline could no longer afford to get their silk 'machine twisted' even if this became necessary; members

» Gernet, *{4),* p. 361.

[6] In this context we can only reason about the various factors which should be taken into account. The task of furnishing evidence from Chinese sources, especially from the local gazetteers, can only be met within the context of an elaborate study on this aspect of Ming history which still has to be written.

° Gernet *(4),* p. 347.

[4] Fanke and Trauzettel (/), p. 248; Ho Ping-Ti (5), p. 10.

[e] Ho Ping-Ti (5), pp. 281-2. ' Anon. *{717).*

[1] 洪武 [2] 住作 [3] 輪班

of the family performed the task more cheaply, if one disregarded the working time involved, and this was never counted in the cost of production.* Indeed, because of the fluctuation of raw silk prices and the fact that raw silk had to be converted into silver—which always meant a loss for the small silk producers who depended on nearby markets and could not profit from 'cheap silver' on the black market—peasant households became forced to rely on their own members performing the task.

Silk merchants, brokers and the workshops which did weaving probably had no interest in setting up multiple spindle spinning-frames and thus investing money in expensive machinery. It could be invested otherwise more profitably. The easy availability of hired hands to do the warp-twisting, made the permanent employment of workers to twist warp-threads superfluous. The 'hall seniors' *{thang-chang[1])* were the people who hired cheap hands to do twisting when there was a need to have twisted warp-threads *(ku kung hui yao[z])*; these men were present in every silk weaving workshop, six of them, holding office for a year, were in the Su-chou workshop, for instance.[b]

Because of the increase of population a labour force, subject to exploitation, was always available.[0] No longer did considerations of time, labour, quality and mutually agreeable processing conditions call for the use of a multiple spindle silk-twisting frame for warp-threads as was the case in the Sung. The desire to make high profits—for which the Ming times gained some reputation, favoured by the general economic and demographic conditions—dictated the choice of the means of production. Hired hands proved to be the cheapest.

Such an explanation of what happened to the multiple spindle silk-twisting frame in Ming times—an explanation which is still hypothetical—may not fit into the theory about 'sprouts of capitalism' during this period, but it certainly helps to understand the sudden 'disappearance' of this type of frame.

We can now turn to illustrations of the multiple spindle silk-twisting frames. We do not know how the Sung frame worked in detail but we may assume that its structure and function resembled in general the frames handed down to us from late Chhing times and the early Republican decades (Fig. 245; Fig. 246).[d]

The textile engineer and historian Tsou Ching-Heng[3] informed us[e] that a relatively simple twisting-frame *(chia-nien-chhe*)* could be found in the thirties and forties in the silk producing rural areas of south-east China. He made a sketch

[a] We should note that the introduction of the labour-saving silk-throwing frame to Cologne in + 1412 to + 1413 did not take place for social reasons; indeed the council of Cologne feared unemployment of silk throwers; Endrei and Stromer (1), p. 90; Loesch (1), vol. 2, p. 418.

» *Su-Chou Chih Tsao Chii Chih* (Report on the Silk-weaving Workshops of Suchou), ch. *10, jen-i*.

[0] A short but instructive description of the working conditions of weavers producing fancy silks is to be found in 'What the weaver said' by Hsü I-Khuei[6] of c. + 1400 in the guise of a moral lesson; see Cheng Thien-Thing *(1),* pp. 65-76; Ebrey, (3), pp. 141-2.

[d] Huang Kuo-Liang (7), p. 189. [e] His letter of 20 April 1978.

[1] 堂長 [2] 雇工掏搖 [3] 鄒景衡 [4] 加撚車 [5] 人役
[6] 徐一夔

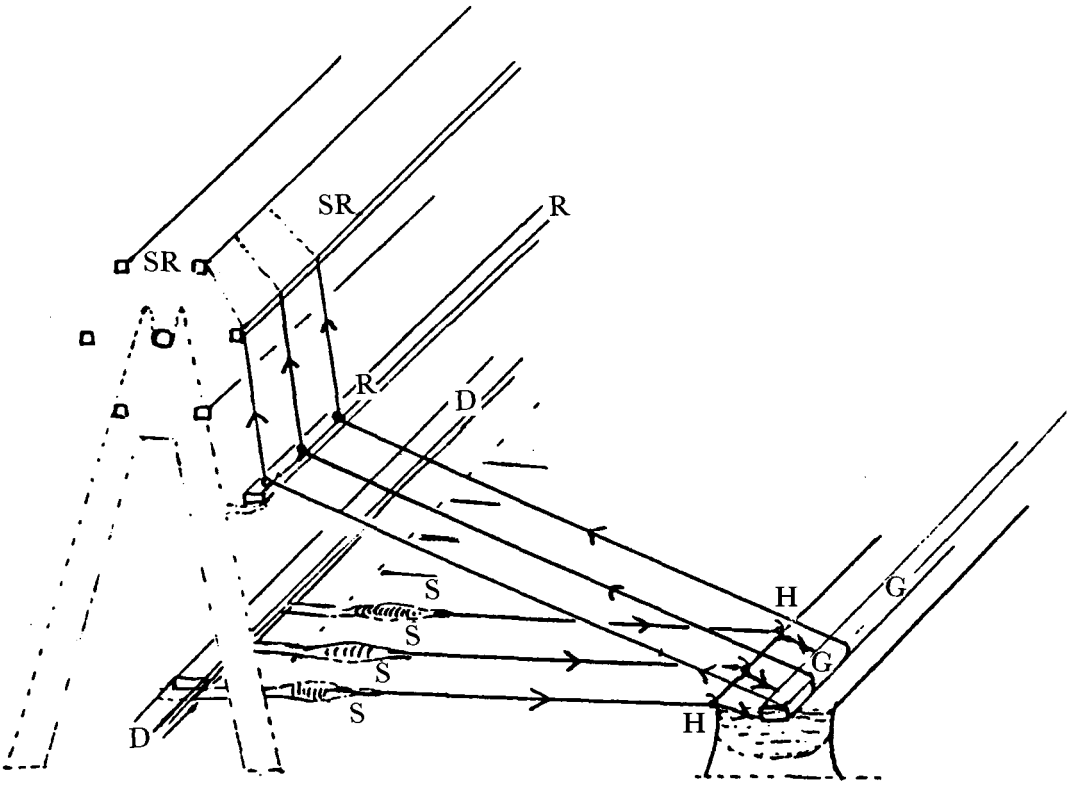


Fig. 245. Multiple spindle silk-twisting frame (*chia-nien-chhe*), 19th and 20th centuries. S, Spindle, H, Hook. G, Glass-rod. R, Ramping-board with hooks. SR, Silk-reel. D, Driving-belt. The drawing is based on a description and drawing by Tsou Ching-Heng in his letter of 20 April 1978.

of the frame which we have redrawn (Fig. 245). The thread went from the driving-belt driven spindle to a hook, passed under a glass-rod in a water tray, went up to the guiding-hook on the oscillating ramping-board and was wound on to the reel. Up to 50 spindles could be arranged parallel. The actual twist was put into the thread by the rotation of the spindle between the spindle and hook on the rim of the water tray.

Another type with two reels which does not, however, belong to the same tradition of frame-construction, has its spindles arranged in a separate frame (Fig. 246). There are eight spindles on each side and the driving-belt runs in a channel in the middle, rotating all the spindles simultaneously. The threads are guided through glass orbs and are drawn on to the slowly moving reels.[a] Similar types can be found in Japanese publications of the 19th century.[b]

The multiple spindle silk-doubling (and throwing) frame of the late 19th century follows in the tradition of the ramie spinning-frame as we know it from

[a] Schwarz (3), p. 2150.

[b] *Kogai Kinu Furui Taisei*, (published + 1815), pp. 165–9; simpler types with only one reel are pictured in *Kishoku Ihen*, (published + 1830), pp. 55–8.

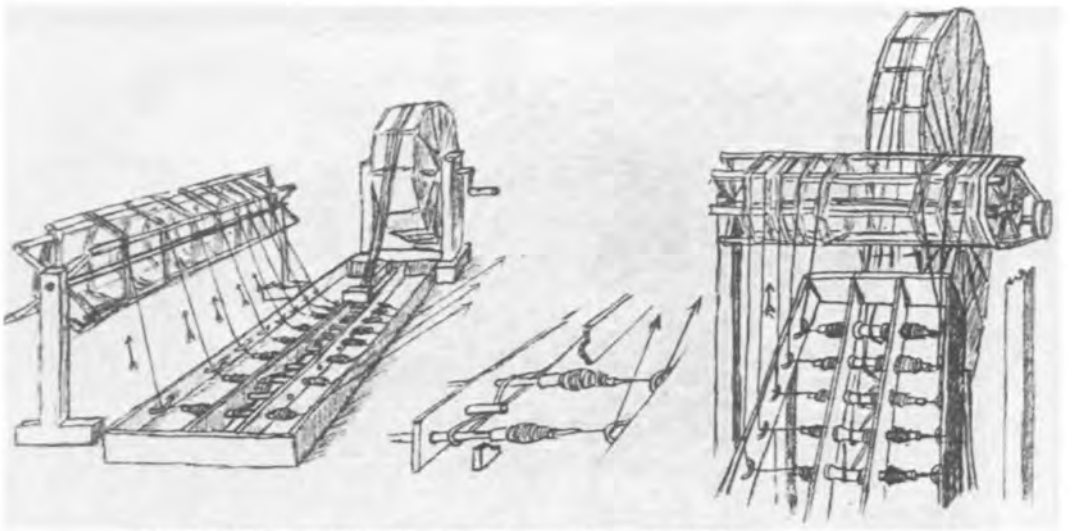


Fig. 246. Multiple spindle silk-twisting frame with two reels. Schwarz (3), p. 2150.

Sung-Yuan times, and certainly developed from a type of twisting-frame such as the one pictured in Fig. 148. This assumption finds support not only in the size of the whole frame but also in its structure, the arrangement of the reel and spindles, and the way they are rotated by driving-belts. According to the text in the *Tshan Sang Tshui Pien* of + 1899[81] we have to distinguish two kinds of warp doubling or thro wing-frames : one is the Kiangsu-Chekiang type, the so-called warp th rowing-frame using the wet spinning method *(shui-fang yao-ching-chhe*[1]*)* (Fig. 247), and the other is the Szechwan type, known as the warp throwing-frame using the dry spinning method *(han-fang yao-ching-chhe*[2]*)* (Fig. 248). The structure of both frames and the way they work are extremely complex (Fig. 249). Terminology differs according to regional traditions and predilections, and because of the length of the texts we have to concentrate on essential characteristics so as not to get lost in the sea of terms.

The framework of the machine consists of four posts *(ma-thui-mu*[3] (K), *hsiang-thui-mu** (S))[b] measuring some 128 cm in height. Bottom crossbars *(heng-chheng-mu*[5]*)* and smaller upper crossbars, measuring 80 cm (and 35 and about 20 cm respectively), make the side-view of the post-structure look like a triangle. The length of the frame—which does not include the driving-wheel—ranges between some 205 cm and 230 cm, depending on whether the measurement is taken at the inside or the outside of the frame. The two bearings *(mu-sha-mao*[6]*)* for the reel-axle are fixed to the top of the posts. On the surface of each of the two long bars

[a] *TSTP*, ch. 5, pp. I2a-i9b; ch. II, pp. 39b~43a.
[b] K = Kiangsu-Chekiang; S = Szechwan terminology.

[1] 水紡搖經車 [2] 旱紡搖經車 [3] 馬腿木 [4] 象腿木 [5] 橫撐木
[6] 木紗帽

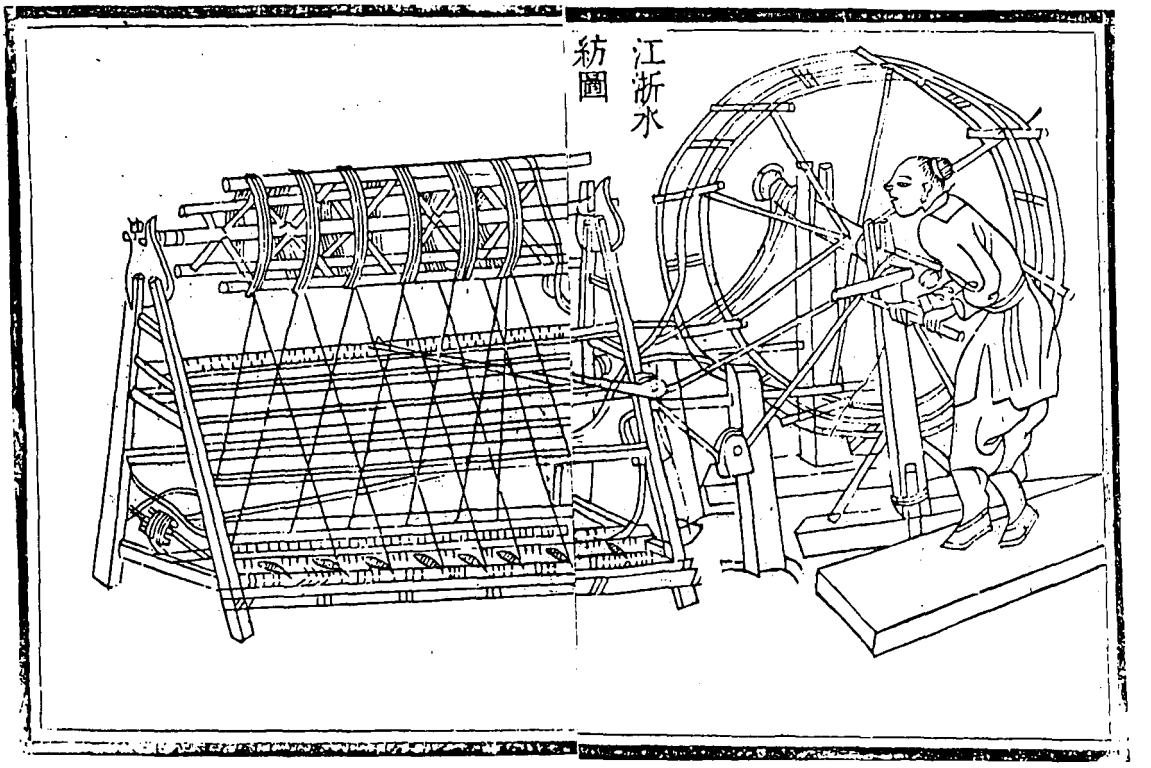


Fig. 247. Warp doubling and throwing-frame using the wet spinning method, Kiangsu-Chekiang (*Chiang-Che shui-fang thu*), + 1899. *TSTP*, ch. 11, pp. 40ab.

{ta-phan-yao[1] (K), *men-khan*[2] (S)) on either side of the frame rows of bamboo nails *(kuan-ssu chu-ting*[3]*)* are lined up. They are like small chopsticks each with a length of about 6.5 cm, and they help control the silk threads on their way from the spindle to the reel. The two long bars measure some 205 cm in length, and join the posts.

The silk threads are drawn from rotating spools *(yii-thung*[4] (K), *yü-tzu** (S)) which are arranged horizontally on the spinning-boards *(tang-pan*[b]*)* .[a] The boards are made not only to hold the spindles of the spools but also provide the channel for the driving-belt, which rotates the spindles on both sides of the board. The composition of each spindle—25 on each side in Kiangsu and 28 in Szechwan—consists of an iron axle *(fang-ssu-ting*[7] (K), *kuan-tzu-ting*[8] (S)), some 22.5 cm long which perforates a small bamboo tube *(hsiao-chu-kuan*[9]*),* and serves as an axle for two thread-bearing spools. Empty spindles could be exchanged for filled ones by placing them on the axle.

* The character *tang* can also be pronounced *thang.*

[1] 大盤搖 [2] 門坎 [3] 管絲竹釘 [4] 籥筒 [5] 籥子
[6] 邊板 [7] 紡絲釘 [8] 管子釘 [9] 小竹管

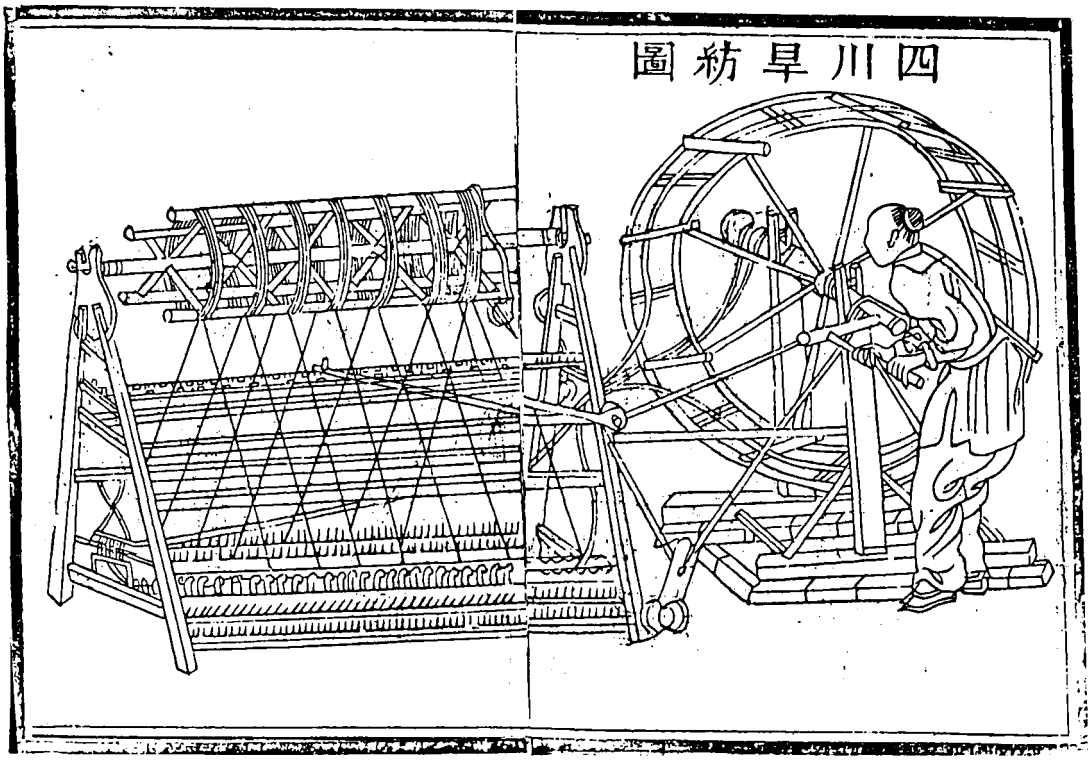


Fig. 248. Warp doubling and throwing-frame using the dry spinning method, Szechwan (*Ssu-chhuan han-fang thu*), +1899. *TSTP*, ch. 11, pp. 42ab.

The Kiangsu-type frame has a water tube *(shui-ku-lu*[1]*)* with a length of some 230 cm and a diameter of about 13 cm placed outside the posts near to the ground. A rod about 205 cm long which presses down the warp-threads *(ja-ching-mu*[2]*)* is placed inside the tube. About 32 cm above the water tube another rod *(yao-chu*[3]*)*[b] can be found supporting the silk threads on their way to the horizontal (perforated) rod, the so-called *thien-phing-chu** (S) or *lung-kan-chu*[5] (K), folding *[kung ssu*[6], doubling) the warp-threads coming from the spindles on both sides of the spinning-board. They ascend to the perforated and oscillating ramping-board *(chiao-kun-chu*[7] (K), *chhi-ssu-kan*[8] (S)), moved back and forth by the pulley-driven eccentric lug *(chiao-pan-chu*[9] (K), *chiao-kun-chu*[10] (S)), which measures some 90 cm.

The Szechwan method replaces the water tube by a water soaked board *(shui-lin*[11]*)* having a prepared bamboo rod *(shui-lin-chu*[12]*)* covered with wet felt

[b] *Chu* generally means a vertical post, but here it has to be understood as a horizontal rod because of its length.

[1] 水鼓轆 [2] 壓經木 [3] 搖柱 [4] 天平竹 [5] 龍竿竹
[6] 拱絲 [7] 交棍竹 [8] 起絲竿 [9] 交板竹 [10] 交棍竹
[11] 水淋 [12] 水淋竹

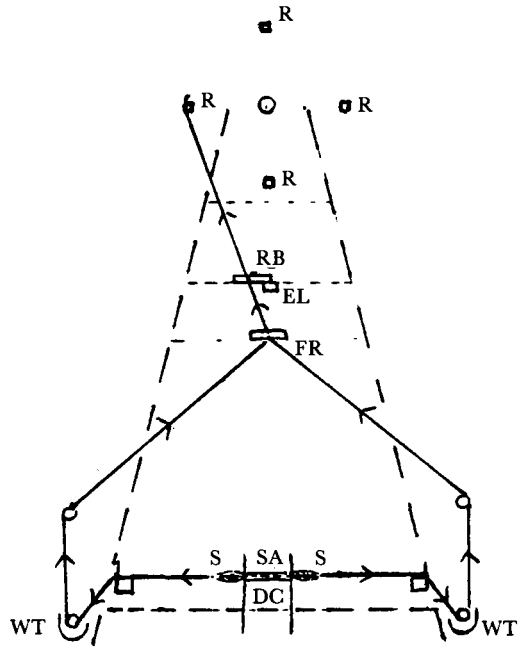


Fig. 249. Side-view of the multiple spindle doubling-frame, Kiangsu-Chekiang type, 19th century. R, Reel rails. RB, Ramping-board. EL. Eccentric lug. FR, Folding rod. WT, Water tube. S, Spindle with spool. DC, Driving-channel. SA, Spindle-axle.

(shih chan[1]). Which method was used, depended on the climatic conditions and the easy supply of water. Both frames gave the same result: a clean thread with a strong twist and a bright lustre.

The doubled or thrown warp-threads are wound on to the reel. Two types of reel are distinguished in the text: for doubling the Chinese preferred the composite reel *(hua-mari[2]-)* unit consisting of four or five reels *(chia[3])* on one axle, and for throwing the complete reel *(thung-man*)* unit, which uses one reel only. The complete reel had six rails *(thui[5])*[&] and five spokes *(chheng[6])* arranged in five groups on the axle[b] making 30 spokes altogether or, when arranged in three groups with a broader spacing, 18 spokes. On the other hand, the composite reel unit consisted of four or five reels either with cross-shaped spokes and four rails, or even of more spokes with six rails.

The driving-wheel *(chhe-luri[7])*—with a diameter of some 192 cm to 205 cm—is operated by one worker turning the crank-handle *(mu-kuai-pa*).* The axle of the wheel *(chhe-chou[9])* with a length of between about 96 cm to 102 cm and a circumference of between some 38 cm to 54 cm, is placed in the bearings of two posts,

[a] Normally *thui* has to be understood as spokes, though here rails are indicated.
[b] The Chinese text lacks clarity; we read of 5 spokes and 6 rails. This does not seem to make sense.

[1] 濕毡 [2] 花幔 [3] 架 [4] 筒幔 [5] 腿 [6] 撐
[7] 車輪 [8] 木拐把 [9] 車軸

which themselves are tenoned into base-boards (*chhe-tho*[1] (K), *chhe-tho-ni*[2] (S)). The Kiangsu–Chekiang type has a horizontal bar (*ting-heng-chheng*[3]) passing through an upright prop (*ting-chheng-chuang*[4]) joining the wheel-structure to the frame-structure.

The driving-wheel is made of two bamboo rings (*erh-phan-chu*[5]) held together by twenty short rods. It serves at the same time as a type of bearing surface (*ya-chhüeh-khou*[6]) for the driving-belt (*chiao-sheng*[7], *ma-pien*[8], *chhe-pan*[9]). The driving-belt for the spindles has a length of about 10 m. Just opposite the driving-wheel at the end of the frame we find a small wheel (*yin-thou-lo*[10] (K), *hua-chhe*[11] (S)) which returns the driving-belt to the driving-wheel. The twenty short rods are joined to the axle of the wheel by a corresponding number of spokes (*chhe-piao*[12]). At the end of the axle, opposite the crank-handle and outside the post, a kind of pulley (*po-thou*[13] (K), *huo-thou*[14] (S)) is fixed; this moves the driving-belt for the reel (*man-sheng*[15], *chiao-sheng*[16] (S), *yu-sheng*[17] (K)). This belt measures about 576 cm in length.

Beside the two driving-belts named above, one other sort existed which is not specially mentioned in the text but can readily be seen on the illustration. It was used to drive the pulley with the eccentric lug which rocked the ramping-board. This belt or rope also went around the driving-wheel axle on the side of the crank-handle, passed under the roller (*huo-ku-lu*[18] (K)) of the 'horse-ear' (*ma-erh-to*[19]) at the outside of the upright prop (*chheng-chuang*[20] (K)) or of the 'cat-ear' (*mao-erh-to*[21] (S)) which was a small fork-shaped post in the top of which the roller was placed revolving around a horizontally arranged short axle. From there the belt went around the pulley (*chiao-lu-lu*[22] (K), *chiao-kun*[23] (S)) driving the eccentric lug and the ramping-board. In this way the driving-wheel and its axle fulfilled various functions simultaneously.

Usually the Kiangsu-type doubled 25 warp-threads from 50 spindles, the Szechwan type up to 30 threads from 60 spindles. Furthermore, doubled warp-threads could be thrown, twisting five or six into one thread as the weaving workshops wanted. By this labour-saving method one frame-operator could process daily the same output as 100 to 112 hand-throwers. So it cannot surprise us that the Szechwan frame in particular gained some reputation for being a highly economical warp-thread twisting device. As we have already mentioned when discussing the silk-reeling frame, the re-appearance of twisting and doubling-frames must be viewed as intimately connected to the increase of silk production towards the end of the 19th century due to expanding silk exports. Furthermore, frame-processed warp-threads could better meet the European and American demand for uniform silk thread qualities than could the hand-processed ones.

[1] 車柁 [2] 車托坭 [3] 頂橫撐 [4] 頂撐樁 [5] 耳盤竹
[6] 鴉雀口 [7] 交繩 [8] 麻辮 [9] 車絆 [10] 引頭絡
[11] 滑車 [12] 車標 [13] 撥頭 [14] 活頭 [15] 幔繩
[16] 交繩 [17] 油繩 [18] 活鼓轆 [19] 馬耳朵 [20] 撐樁
[21] 猫耳朵 [22] 交轆轤 [23] 交滾

(7) SILK MACHINERY IN EAST AND WEST

Above we have given details of a few Chinese inventions in the field of textile technology which made their way to Europe in medieval times. These included the spindle-wheel and the reel. Now we hope to substantiate the idea of transmission in the technology of silk production from East to West. It is not possible in this context to discuss the history of the silk-road, silk and sericulture outside China proper, but a few remarks about the diffusion of the product silk and of sericulture generally appear to be necessary. They may help to a better understanding of the influence of'silk-China' on Europe; indeed, the commonly used name *seres* to label silkworms toward the end of the pre-Christian Roman times derived from the Chinese JJK[1], silk.

Korea and Japan profited very early from Chinese sericulture learning to rear silkworms, cultivate mulberry trees and to weave silk fabrics. In the — 2nd century Chinese immigrants brought silk culture to Korea,[a] while from as early as the year — 28 we hear of silk fabrics in Japan,[b] though we do not know where they were produced. In the middle of the + 3rd century, the Japanese had mastered the rearing of silkworms.[0]

In Europe, various sites prior to the - 3rd century have yielded fragments of Chinese silk produced from domesticated silkworms; this was the case with the tomb no. 6 of Hohmichele in south-west Germany, dated as belonging to the — 5th to —6th centuries,[4] together with a similar grave at Rheingönheim, Sarmatian graves at Shipovo, and Marienthal in the Volga region, a site at Kerch in the Crimea,[6] and finally a grave of the Kerameikos in Athens.[1] There are also a number of other finds from — 3rd century tombs.[g]

So we may say that silk fabrics certainly came to Europe by inter-tribal barter trading[11] many centuries before the 'opening' of the silk-road[1] by Chang Chhien[2] in the —2nd century during the Han dynasty, and who was therefore celebrated as 'the first Chinese who penetrated to the extreme regions of the west' and hence was spoken of by ancient historians as having made a road.[j] Thus it is clear that this route of inter-cultural communication had already played an important role many centuries before its 'official discovery'.

Though the various tribes in Europe cherished the silk, they could not explain

• Eberhard (i), pp. 15-16. [b] Aston (1), vol. 1, p. 166.
[c] *Wei Shu*, ch. 30, p. 855; Sansom (1), p. 45.
[d] The silk embroidery on a woollen cloth was very thoroughly analysed, and published by Hundt (i), pp. 199-214; Hundt (2), pp. 59-71.
[e] Bibliographical notes and further information are supplied by Raschke (1), p. 610 (plus footnotes).
' Hundt (2), pp. 65-71. [B] Raschke (1), p. 625.
[11] *Ibid.*, p. 609.
[1] From the vast number of books and articles published on 'the silk-road', we would like to mention only few: Herrmann (6); Herrmann (a); Teggart (1); Boulnois (1); and Wada (1). For more information about the silk-road and its commerce, see Raschke (1), p. 719, no. 250-5; see also Nagasawa Kazutoshi (/).
' Giles (1), p. 12, no. 29.

[1] 絲 [2] 張騫

its origin. In his learned article on 'China and Rome' John Ferguson refutes the widespread notion that the ancient Greeks—Ctesias, Aristotle and Alexander in particular—had any concrete idea about the origin of Chinese silk.[a] Starting from the early years of the Roman empire, however, the use and the knowledge about silk gradually increased. In his excellent and profound study on the subject Manfred G. Raschke arrived at the following well supported conclusions:[b]

The analysis presented above necessitates a re-examination of other long-cherished beliefs about Roman trade with the Far East. Not only did China not derive any overall material advantage from its export of large quantities of silk, since most of this was given away rather than sold, but also no effort was made to maintain a monopoly of silk production.[0] This mistaken belief has crept into many modern publications and seems to originate in the economic thought of eighteenth century mercantilism. It is also necessary to reject the view that the silk-trade was dangerously detrimental to the Roman economy.

We should also mention[4] the Near East (Syria and Palestine) and Egypt,[6] which imported raw silk and fabrics from China and had a flourishing silk-weaving industry even in the +2nd century, as well as Persia and Byzantium which followed in the +4th century.'

1° +552, after state monopoly of the silk industry had been established, emperor Justinian succeeded in introducing the silkworm, *Bombyx mori* L., to Byzantium.[8] The importance of this cannot be overestimated because the people who introduced the silkworm, whoever they may have been (monks or merchants), and however they 'smuggled' it from China, also knew how to breed it (Fig. 250). Moreover, they brought with them a knowledge of silk technology and taught the Byzantines how to apply it. Justinian attempted to make the Byzantine silk industry independent,[11] but it was not able to produce as much silk as required until the + 10th century.[1] The main reason why it developed so slowly is that no privately run silk industry was allowed.

The Italian silk industry of the + 13th and + 14th centuries also depended on importing raw silk.[1] We know, however, of the two regions in Italy where silk was

[a] Ferguson (1), p. 582. [b] Raschke (1), p. 623.

[0] Tsou Ching-Heng *(3),* pp. 24-7.

[d] Lach (5), vol. 1, p. 81 : 'The details of this history have never been thoroughly worked out, and because of their complexity, perhaps they never will be.'

[e] Patterson (1), p. 197. ' Patterson (1), p. 197.

[g] See above, Vol. 1, pp. 185-6; Heichelheim (1), p. 2756; there the years +553 or +554 are given.

[h] Markowsky (1), p. 14.

[1] Lopez (6), p. 72: 'Although the silkworm was introduced to the Byzantine empire in the age of Justinian, as late as the tenth century importers of raw silk to Constantinople were exempted from the customary sales tax, no doubt because local production was insufficient to feed the thriving industry of the city.'

) Lopez (6), p. 72: '. . .Spain and Sicily may have used local raw silk, but there is no indication that they could spare any for export. In northern Italy the earliest mention of domestic production of raw silk, in the first half of the tenth century, antedates the earliest mention of silk manufacturing. The industry, however, grew so fast that local production of the raw material did not catch up with the demand before the end of the middle ages.' And we may add that Italian cities—even in the + 14th and + 15th centuries—• taxed cocoons and mulberry leaves which certainly limited the production; see Silbermann (1), pp. 223-4. Hence until the + 16th and + 17th centuries sericulture increased only slowly.



Fig. 250. Two monks handing over 'silkworm seeds' to the Emperor Justinian, illustration *c.* +1580. Stradanus (1), pl. 2.

first produced; one, in northern Italy, in the Po valley, where raw silk production started in the + ioth century,[a] most probably as a result of Byzantine commercial and political influence on Venice in the century before.[b] The other was in the region of Salerno in southern Italy, originating in the first half of the + 11th century.[0] (There is, however, one earlier find of silk in the Salerno area: a fabric of Byzantine origin with a lining of Neapolitan purple dating from the + 9th century.)«[1] We can be certain that in southern Italy most of the work of mulberry cultivation was carried out by Jewish, Greek and Arab immigrants who brought their expertise from Greece and the Near East.[e] One proof of this wave of colonists in Sicily is the gravestone of 'Ibrahim the brocade-weaver', dating from + 1072. So we can see that all these activities began long before the Norman ruler Roger II settled weavers from Greece in the city of Palermo in + 1147.[g]

The commercial success of Italy in the silk markets of Europe started as early as the +13th century, especially for the cities of Lucca, Venice and Florence.[11] This is mainly explained by the fact that all the other regions producing silk fabrics were facing very difficult situations; Persia and Mesopotamia were suffering under Mongol invaders, Byzantium was the seat of the Crusaders, and in Sicily the reign

» Lopez (6), p. 73, n. 3.
[b] Heichelheim (1), p. 2579.
[c] Tescione (1), vol. I, p. 8.
[a] Markowsky (1) p. 16.
[e] Markowsky (1), p. 16.
' Day (1), p. 114.
[g] Falke (1), vol. 1, p. 120.
u Markowsky (1), p. 16.

of the Hohenstaufens collapsed in the middle of the century.[8.] Such political conditions may have encouraged Italian cities to tax the production of silk heavily, for they could still be certain to sell the silk fabrics and make large profits.

It was quite certainly the influence of the Eastern Roman empire which helped to develop Italian sericulture. Not so in Spain, where the Arabs introduced silk technology in the + 8th century.[b]

In our opinion, the implements and machinery for silk production were transmitted from China to Europe mainly by merchants and over a long period. It is still an open question exactly when and how it happened, but that the transmission took place from East to West can be accepted. We have been unable to find a single trace of silk machinery in Italy before the +i3th century. But in that century commercial penetration into the Asian continent by Italians, as Robert S. Lopez has already pointed out,[c] was much more than a collection of isolated adventures. The northernmost route from the Crimea to Peking was 'perfectly safe by day and night' Pegoletti tells us, and Lopez has concluded 'it paid to export direct to China the finest French and German linen and bring back silk, because the price difference outweighed the cost of those light, valuable wares... '[d] So we have come to the conclusion that the whole technology was taken over step by step from Byzantium and the Near East, that is to say, originally from China.

We have already seen that Chinese origin can be ascertained for many inventions in the field of thread processing techniques. The spindle-wheel and the reel may serve as examples, and today nobody doubts that the Chinese had mastered the cultivation of domesticated silkworms more than at least 4,000 years ago. We have also been able to provide evidence bearing witness to the long tradition of craftsmanship in silk processing techniques in China.

Historians agree that silkworms were imported to Byzantium in the +6th century;[6] but of what use were they without the accompanying sericultural techniques? Hence a few fundamental silk processing devices must have been known and used[1] in the Byzantine empire. Probably by the + 9th and certainly by the + 10th century silkworm breeders in northern Italy had mastered the essentials in the trade, but strict secrecy surrounded all Italian medieval silk-reeling machinery so that nothing is known of its history in that country.[8]

We have provided evidence that the +11th century silk-reelers in China already worked a treadle-operated silk-reeling frame with a ramping-board and a roller-system. The earliest illustration of an Italian silk-reeling frame, a drawing by Campagnola dates from about +1510 (Fig. 25i).[h] The cocoons were reeled from a hot water basin on to the reel, forming on it four parallel hanks of silk. The main structural features—which are fundamental to the reeling of cocoons—

» Falke (2), p. 26.
b *Ibid.*, p. 19.
[c] Lopez (7), pp. 111-12.
[a] Lopez (8), p. 384.
[e] Hennig (1), pp. 295-312; Derry and Williams (1), p. 27; Pounds (1), pp. 317-18; Lach (5), p. 81.
[1] Heichelheim (1), pp. 2754, 2756-7; Lopez (5), pp. 1-42.
[B] Patterson (1), p. 206.
[h] Gabinetto di Disegni, Florence, no. 1786F; pictured in Patterson (i), pi. 8.

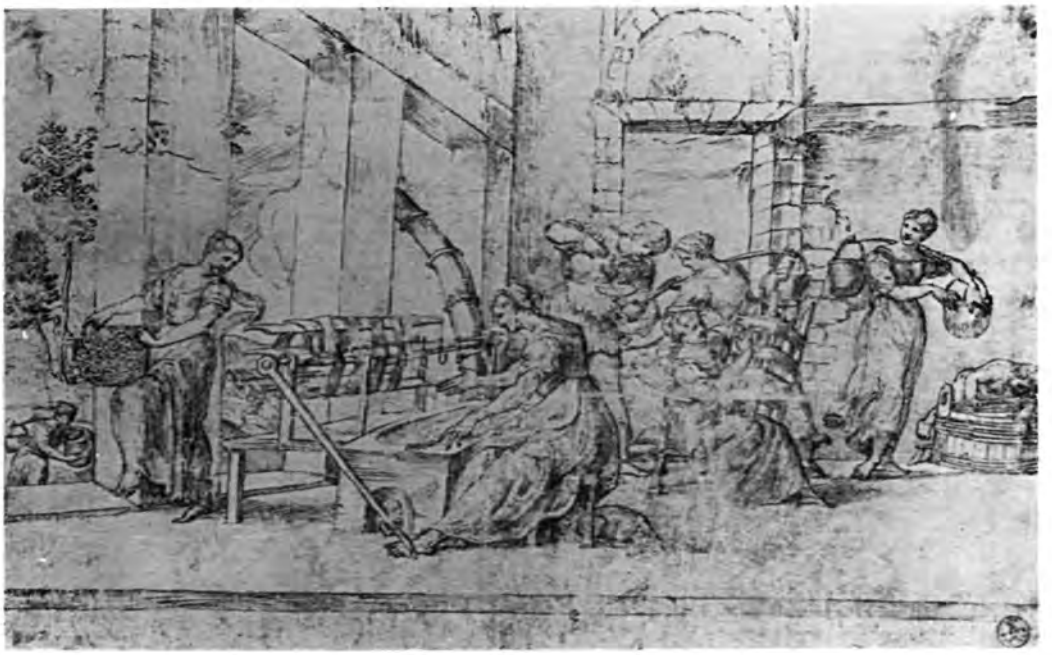


Fig. 251. Silk-reeling frame in Florence, Italy, *c.* +1510. Drawing by Campagnola, Gabinetto di Disegni, Florence (no. 1786F).

like the hot water basin and the reel, all resemble the Chinese types. They certainly were the first elements imitated in the west, being based on oral reports of merchants and travellers who must have had some knowledge about sericulture in China, otherwise silk-reeling could not have taken place in Europe. That the machine was invented in Europe—independently and without knowing of the Chinese devices—appears rather unlikely. There are not only its main characteristics in favour of a Chinese connection, but also minor details such as the lever joined to the crank with the help of which it was possible to work the reel with only one operator. Furthermore, there was the problem of smoke nuisance, which was elegantly solved by a chimney. Even in these minor details the silk-reel builders tried to follow the 'Chinese method'. Neither the smoke-pipe nor the treadle are European technical improvements on the Chinese system as Patterson assumed.[11] Both pieces of equipment were known and used in Sung China. And as far as the foot-operated reel is concerned, the incomplete transmission of the mechanical nature of the Chinese treadle mechanism clearly demonstrates how incomprehensible such an ingenious device must have been to the non-Chinese, for the European lever lacks all the elegance and efficiency of the Chinese pin-balanced treadle of Sung times. So it should be no surprise that the foot-operated reel disappeared and was replaced by the hand-operated reel, which guaranteed

[8] Patterson (i), legend to pi. 8.

Fig. 252. Silk-reels, *c.* + 1580. Stradanus (1), pi. 6.

a better control of rotary motion, as is to be found on later + 16th century illustrations (Fig. 252)[8,] and also on pictures from the + 17th and + 18th centuries (Fig. 253).[b] We may conclude, then, that the short episode of foot-operated silk-reels in Europe must have already come to an end in the + 16th century.

Two excellent drawings of Italian silk-reeling frames of the kind favoured by the Lucchese silk-reelers, are contained in a manuscript of + 1745, written by the German artist Christoph Martin who hailed from Saxony.[0] The *caldara bassa,* the low reel (Fig. 253), operated by two persons, produced two silk hanks of finest quality in parallel. The reel belongs to the type with separate guiding-frame and reeling-frame—well-known from Sung China. The hot water basin and a primitive sort of frame with eyes or hooks (but no rollers) to guide the silk threads are depicted on the left-hand side; the hand-driven reeling-frame with an oscillating ramping-board, obviously driven by a system of cogwheels, we find at some distance on the right side of the illustration. The fine quality of silk produced on this type of small reel-frame was the result of two factors: first that one person attended exclusively to the cocoons and the drawing-off while a second person worked only the reel. Secondly, like their Chinese colleagues, the silk-reelers of Lucca attempted to solve

* Stradanus (1). The illustration is reproduced in Markowsky (1), p. 19, pi. 6; Boulnois (1), pi. 34. Another drawing of silk-reeling is preserved in the Museum of Fine Arts, Budapest, published in Endrei (2), p. 209, fig. 2.

b Anon (6oo), pi. 3; Diderot and d'Alembert (1), vol. 11 (soierie), pi. ia; Chambers and Rees (1), vol. 5, pi. mis. Ill, figs. 45-6; also pictured in English (1), vol. 4, p. 309, fig. 168 (A) + (B).

[c] Roover (1), pp. 2915-17: the manuscript is preserved in the State Archives of Lucca; Trumpy (1).

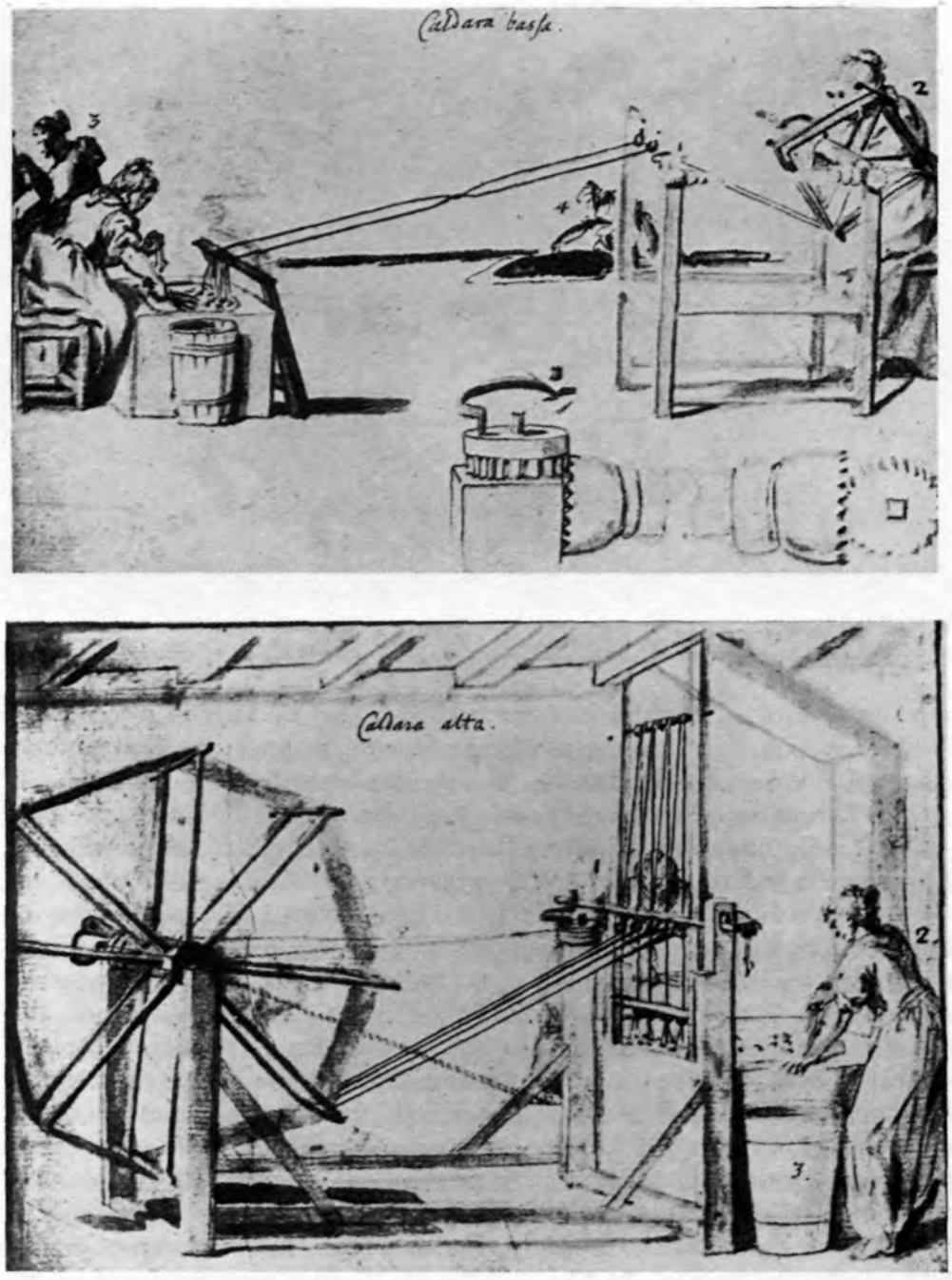


Fig. 253. *Caldara bassa*, the low reel and *Caldara alta*, the high reel, silk-reels of Lucca, +1745. Christoph Martin from Saxony, reproduced from de Roover (1), pp. 2915–16.

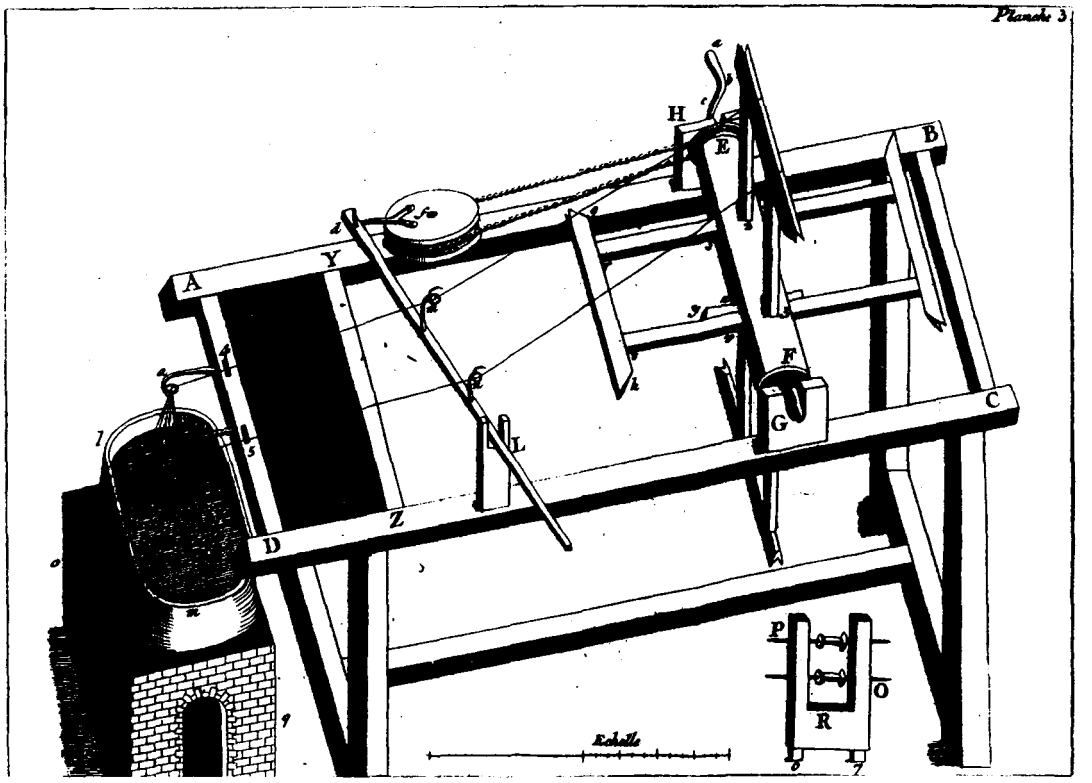


Fig. 254. Hand-operated French silk-reeling frame, + 1754. Anon. (600), pl. 3.

the problem of evening and rounding in the reeling process by using a method of thread-crossing which took place between the guiding-frame and the ramping-board. Such a labour-intensive, slow crossing technique certainly improved the silk quality but it also reduced the rate of productivity. Apart from this Italian method of thread-crossing and the cogwheel-drive, the *caldara bassa* silk-reel clearly displays the general features of the Sung silk-reeling device.

The *caldara alta,* the high reel (Fig. 253), worked by two people, produced four or even more hanks of less uniform silk quality than the *caldara bassa.* The device consisted of a roller-frame on the pan, separated from the reel and the ramping-board and forming one unit. In this illustration we do not find cogwheels but a driving-belt working the pulley of the ramping-board.

The *caldara alta* substantiates the 'China-connection', for we detect the use of a driving-belt and the employment of a roller-frame, which characterised the Chinese silk-reeling frames. In Italy it must have fallen into disuse in the + 18th century, but in this drawing we have a rare and perhaps the only example still extant, which definitely demonstrates its use in Europe. The problem with the roller-frame may have been that its use as an element to perform various crossing methods was probably never realised. In Italy it was employed to lengthen the

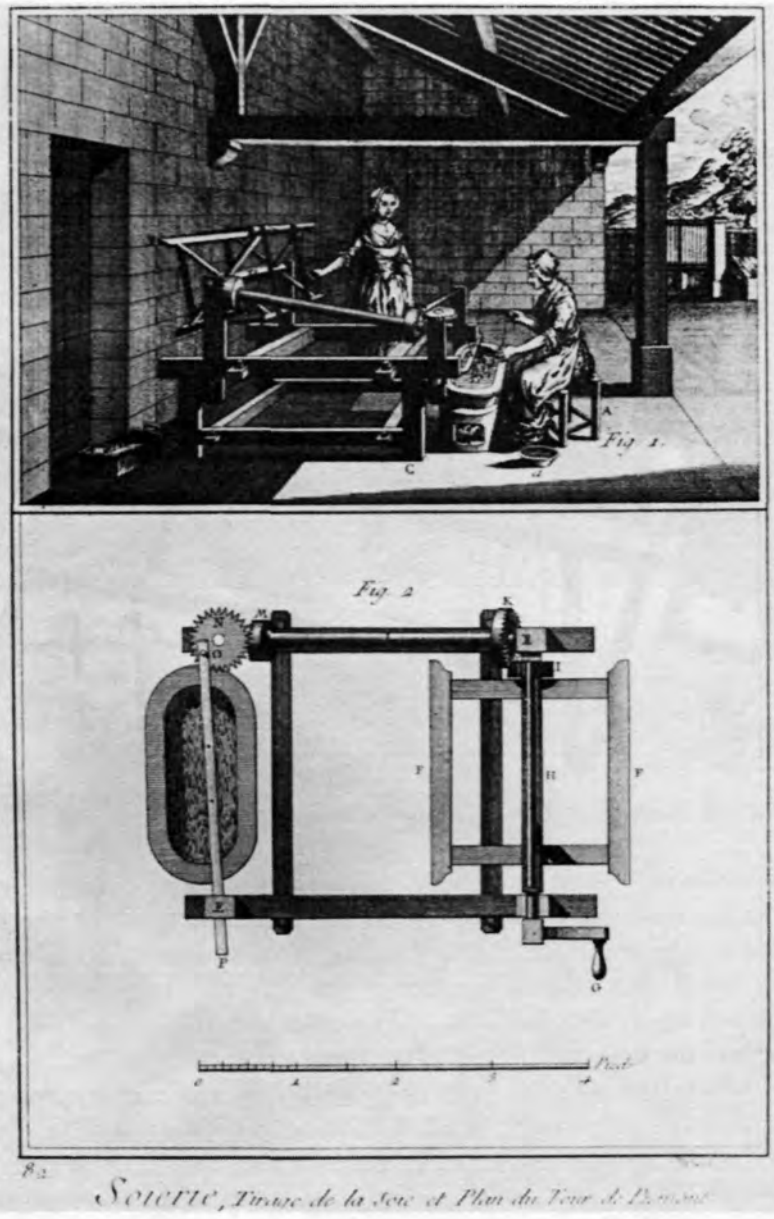
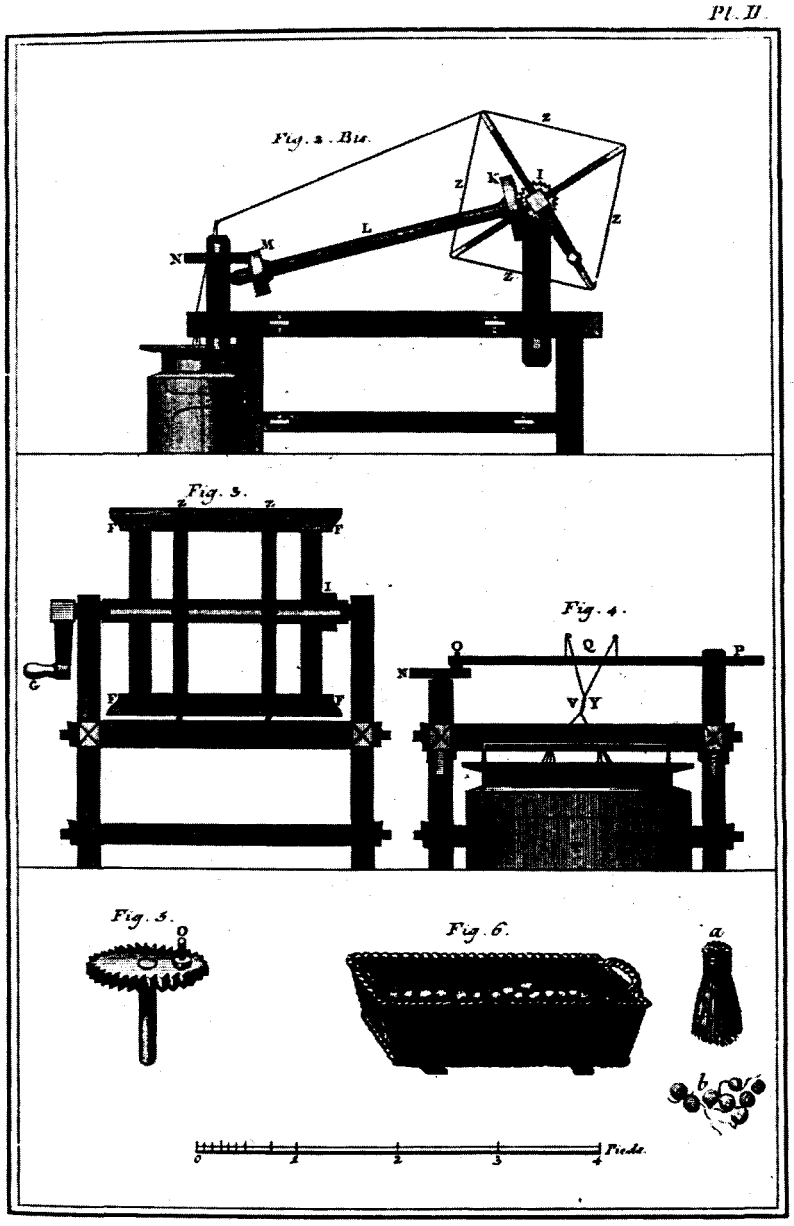


Fig. 255. Hand-operated silk-reeling frame, Piedmont, + 18th century. Diderot & d'Alembert (1), vol. II (soierie), pl. I; figs. 1 and 2; pl. 2: fig. 2.



Soierie, Développements du Tour de Piémont.

Fig. 255*a*. For legend, see opposite.

distance which the silk threads had to cover from pan to reel, and thus helped to get them dry. For the crossing of silk threads other methods were devised in pre-19th century Europe, but these did not prove to be more efficient than the Chinese methods of Sung times. The structure and appearance of the posts of the ramping-board, the pulley, and the driving-belt running round the axle of the reel and the pulley, are all typical features of the Chinese silk-reel structure.

It is interesting to note that technical improvements in silk-reeling frames in China and Italy took the same course. The French silk-reeling frames of the + 18th century (Fig. 254; Fig. 255) resemble in their main structural elements the treadle-operated complete silk-reeling frames of Ming times. From a functional point of view, the Chinese frame was superior in its performance because one single operator could do the job. In Europe two persons were needed, one drawing off the filaments from the cocoons, the other rotating the reel. In China a driving-belt was used, but in France and Italy cogwheels were mostly preferred.

Though we lack textual evidence confirming the Chinese cultural investment in Europe which took place without any activity on the part of the Chinese, the pictorial evidence bears witness to the transfer of the technology of this type of machinery from East to West. The fundamental devices may have come to Europe in the + 6th century, but the design and function of the more advanced silk machinery was probably only introduced to Europe, especially Italy, in the last decades of the + 13th century and in the + 14th, widely known as the period of the *pax mongolica.*

The idea of the design and function of multiple spindle silk twisting and throwing-frames may have been introduced to Europe in the same way as was the case with the silk-reeling frame. As outlined above, their use in China was limited after Sung-Yüan times for various economic reasons. So in all probability technical improvement of the frames did not take place after this; the Chinese frames did not develop into silk frames with high efficiency as we know them from + 13th and + 14th century Italy. That the idea that the twisting-frame—the arrangement and motion of dozens of parallel spindles—came from the East is not only supported by the fact that it suddenly appeared on the textile scene in the + 13th century but also by the economic conditions, which meant there was competition between the Italian cities who were trying to keep the structure and function of the frames a secret.[0]

In + 1272 or + 1276 a Lucchese exile of the name of Bogheniano or Borgesano brought the invention of the water-powered throwing-frame to Bologna. He was abundantly honoured and rewarded by that town, while his effigy was hanged in Lucca.[b] The fact that such a frame existed in Lucca is most remarkable and in itself a strong argument supporting the Chinese influence. Robert S. Lopez reasons 'it preceded by centuries the adoption of similar contrivances in the

[a] Silbermann (i), vol. i, p. 365; Schwarz (3), pp. 2145-53; Patterson (1), p. 206.
b Schwarz (3), p. 2151.

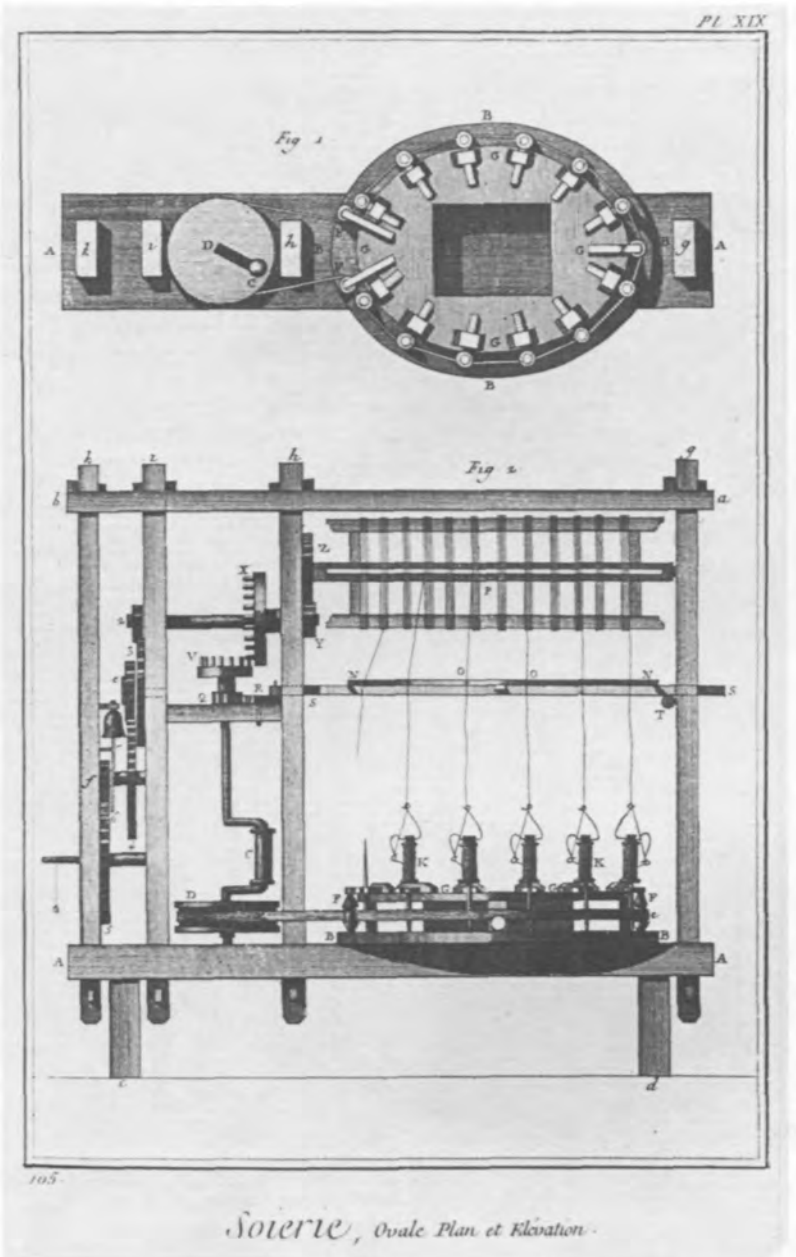


Fig. 256. Small silk-twisting frame with twelve spindles, +18th century. Diderot & d'Alembert (1), vol. II (soierie), pl. XIX.



Fig. 257. Silk-throwing mill, Florence, + 1487. Florentine manuscript of + 1487 in the Biblioteca Laurentiana; reproduced from Endrei & von Stromer (1), p. 100.

woollen industry, though the latter was more definitely geared for mass production.[a] For their own profit as well as the benefit of their own towns, the merchants transporting ideas as well as goods such as raw silk from the Near East and from Asia to Italy succeeded in keeping all silk technology under the control and organisation of special trade institutions.[b] As a result, hardly any indications

[a] Lopez (6), p. 76. [b] Kuhn (7), 52.

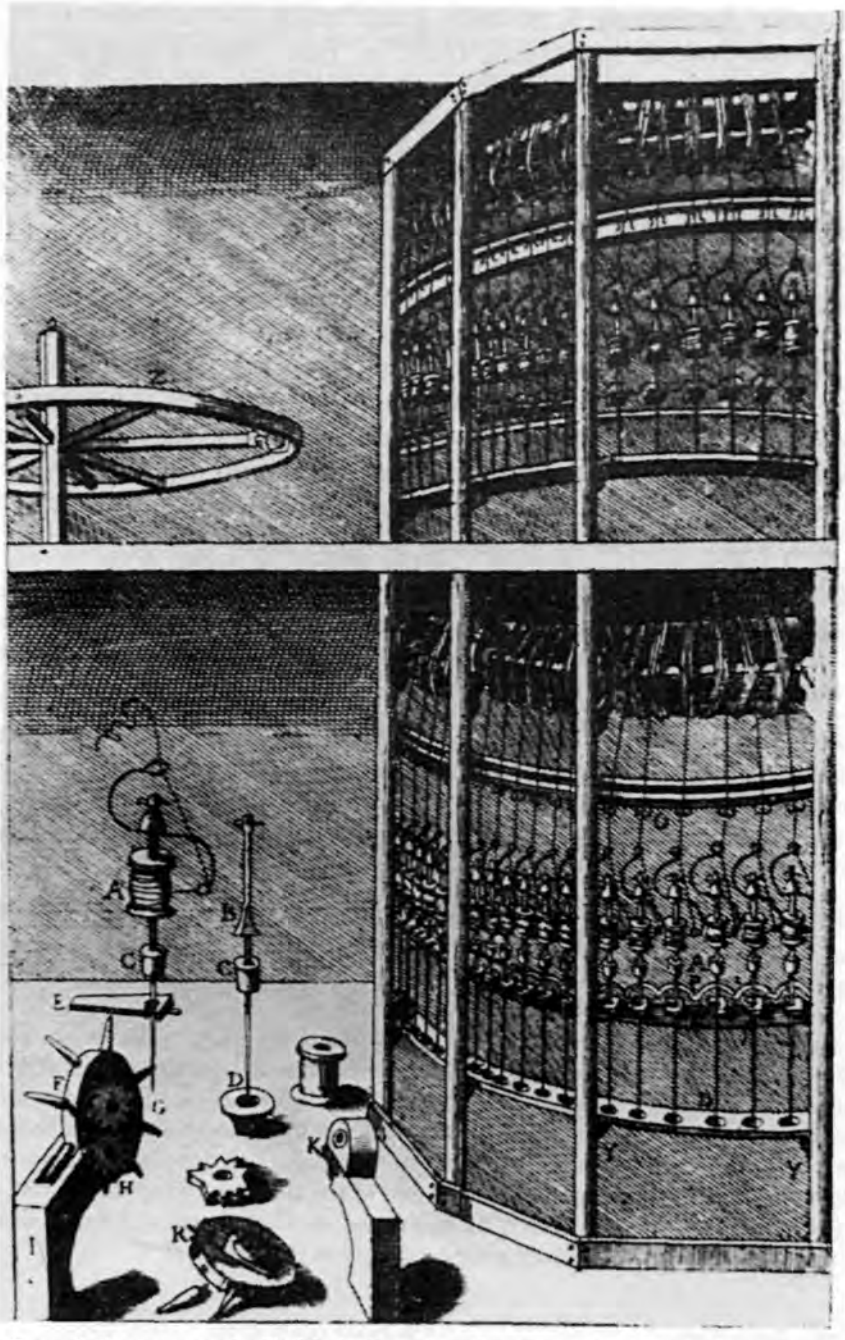


Fig. 258. Water-powered mill 'filatoio d'aqua', +1607. Zonca (1), pp. 69–75; reproduced from Endrei & von Stromer (1), p. 102, fig. 5.

of the working processes are to be found, either in the *Livre des métiers* of Etienne Boileau (Prefect of the Merchants' Guild of Paris from +1254 to +1271), published about + 1260, in the Lucca Statutes of the *Arte della Seta* of + 1298, or in the Statutes of the *Arte della Lana* in Florence of + 1490.» Yet though there is no information about this part of the trade, the guild statutes of + 1308 prescribed that any man from Lucca engaging in the silk industry outside the precincts of the town should be strangled, and any woman burned.[b]

Originally the twisting-frame may have been a spinning-oval with all its spindles driven by a driving-belt (Fig. 256). With this type of spindle-drive, only a limited number of spindles could be rotated if an equal twist in all threads was needed. So as early as the + 13th century this frame was replaced by a bigger silk-throwing mill of higher capacity. Walter Endrei and Wolfgang von Stromer have described how the mill spread to other regions in Italy, to France and to Austria,[0] while a Florentine sketch of +1487 depicts such a mill (Fig. 257), which was widely used during the + 14th and + 15th centuries."[1] Fortunately a decription of such a mill, which was put up to auction in + 1335, is still extant.[e]

. . . adfilandum sericum ad duo valica et decern guindala pro quolibet valico, et decern duo fusos pro quolibet guindalo, cum ducentis quadraginta fusis de ferro et totidem chocchis et totidem schacchettis et mille rocchettis et ducentis quadraginta vetris et ducentis quadraginta coronellis de stagno et triginta stellis de ferro, actum ad laborandum. ..

.. .to twist silk threads (a twisting mill) is set to work (which comprises) two levels with ten reels to each level and twelve spindles to each reel, with 240 iron spindles and the same number of sockets and exchange discs for spindles, one thousand spools (to be placed on the spindles) and 240 glass tumblers, and 240 tin rings on the bobbins and 30 iron cogwheels (to rotate the reels). . .

From Florentine and other illustrations[1] of the mill we can see that the earliest twisting mill resembles the mills of the + 17th century. R. Patterson describes it as follows:[8]

(It) consists of two concentric wooden frameworks about 16 ft. in diameter. The outer is fixed and bears two rows of vertical spindles with a row of horizontal reels above each. The inner rotates about a vertical axis, and its outer laths rub on the spindles and reel-mechanism to rotate them. On each spindle is a rigidly fixed spool, and above this an S-shaped wire that rotates freely on a dome-shaped cap. The untwisted silk yarn passes from the spool and through eyelets on each end of the S-shaped wings to the reel above. When the spindle rotates, and with it the spool, the yarn is twisted, and as it is drawn up by the reel the wings automatically rotate and guide the yarn.

[1] **Schwarz (3), p. 2147.**

[0] Endrei and von Stromer (1), pp. 99-103.

[b] **Schwarz (3), p. 2151.**

[i] **Keller (i), p. 37.**

[e] **Partly quoted in Bini (1), p. 54; Schwarz (3), p. 2147; Patterson (1), p. 207. The entire text of the** development is given in Endrei and von Stromer (1), pp. 116—17.

[f] Patterson (1), p. 206, fig. 171; p. 207, fig. 172; Zonca (1), *JVuovo Teatro di Machine et Edifiai* (Padua, 1607), pp. 69-75; Diderot and d'Alembert (1), vol. 11 (soierie), **pi. VIII,** pi. **X,** pi. **XI, pi. XII.**

[8] Patterson (1), p. 207. An excellent description can also be found in English (3), pp. 65-75.

As we have learned previously, a water-powered mill, *filatoio d'aqua,* was mentioned around + 1272, and it has been pictured by Vittorio Zonca (+ 1568 to + 1602) in his famous *Nuovo Teatro di Machine et Edifiai* published at Padua in + 1607[s] (Fig- 258). But in China no twisting-frame of such efficiency and technical inventiveness existed. Due to economic reasons, the improvement and further development of the Chinese frames after Yuan times did not take place in China but in Europe, where competitive silk production favoured the invention of new techniques and machinery.

[a] Beck (1), pp. 303-6; Endrei and von Stromer (1), p. 102; Patterson (1), p. 207, fig. 172.

APPENDIX: GLOSSARY

Here we can explain only a few technical terms. As far as the Chinese words are concerned we have concentrated on the characters commonly used in pre-modern times. For more information about the technical terms themselves, see Dorothy K. Burnham (i). *Warp and Weft. A Textile Terminology.* Toronto, 1980; Irene Emery (1). *The Primary Structures of Fabrics.* Washington D.C., 1966; P.A. Koch, G. Satlow (eds.) (1). *Großes Textil-Lexikon. Fachlexikon für das gesamte Textilwesen.* Stuttgart, 1965, 2 vols.; Anon. (606). *Textile Terms and Definitions, The Textile Institute* (ed.). 7th ed., Manchester, 1975.

Bobbin — *wei-kuan*[1]
The spool of the weft-thread.

Bowing — *than*[2]
Cotton was bowed by vibrating the string of a bow within the cotton material. The vibrations loosened knots and made the material fluffy.

Carding — *shu-li*[3]
An operation carried out before spinning in which the fibres are formed into the form of a rope having no twist (roving, sliver).

Chaining the warp — *lien ching*[4]*
The task in which the warp is removed from the warping-reel *(thien-huo*[5]*)* or the warping-board *(ching-pa*[6]*).* The warping-reel and the warping-board are devices for arranging the warp-threads to be parallel, having the same length and tension.

Distaff — *chha?*[7]
A long stick, sometimes shaped like a fork, which holds the material to be spun.

Doubling — *shuang-ho*[8]*, ping-hsien*[9]
The step in which two or more single yarns are combined into one by twisting them together in a single operation.

Drawing-out — *yin-shen*[10]
The technique used when spinning plant fibres or wool to obtain an equally twisted yarn in which the whole length has the same thickness. This is achieved when the distance between the spindle and the hand holding the fibres increases without feeding in new fibre material.

Hank — *chiao*[11]*, ching-lii*[12]
The warp-threads in coiled form of definite length as is produced by a warping-reel or a warping-board. See also, skein.

[1] 緯管 [2] 彈 [3] 梳理 [4] 綞經 [5] 天蠶
[6] 經耙 [7] 叉 [8] 雙合 [9] 幷綫 [10] 引申
[11] 紋 [12] 經縷

Heddle — *tsung*[1], *tsung-jien*[2], *tsung-mu*[3]
A loop of thread through which a warp-thread is passed. The heddle or heald is fastened to the heddle frame *(tsung-khuang*[4]*)* or shaft *(tsung-phien*[s]*).* It may be raised or lowered to open the shed to permit the passage of the weft-thread.

Onos (epinetron) — *wa*[6]
An earthenware tile used in rolling fibres. It was placed on the thigh.

Quilling — *sui*[7], *fang-wei**
To combine by twisting together two or more simple yarns or silk threads used for the weft of a fabric. Practically speaking, it is like doubling.

Reel — *khuang*[9], *hu*[10], *huo* or *yiieh*[il], *chhe*[12]
i. A device around which silk is wound as it is reeled from the cocoons.
2. Any rotary apparatus on which thread may be wound during manufacture (hand-reel *tiao-huo*[13]*).*

Reeling — *sao*[14], *chih*[ls]
To unwind the silk filaments from the cocoons.

Roving — *fang-thiao*[16]
The name given to the relatively fine fibrous strands (which are rope-like without a twist) used in the later or final stages of preparation for spinning.

Skein — *chiao-ssu*[17], *ying-tzu*[lS]
Often regarded as a synonym for hank; used in this study (with one exception) in the sense of reeled silk removed from the silk-reel. *Ying-tzu*[19] was the term for a hank or skein of hemp.

Sliver — *thiao-tzu*[20], *sha-thiao*[21], *shu-thiao*[22]
An assemblage of fibres in the form of a rope without any twist (synonym of roving).

Spindle — *ting*[23], *thing*[24], *kuan*[2s]
The tool used for spinning thread. The hand-spindle *(shou-fang-ting*[26]*)* consists of a spindle-rod or spindle-shaft *(chou*[27], *mu-kan*[2S]*)* and a spindle-whorl *(tho*[29], *fang-chuan*[30], *fang-chui*[31] (or *chhui), fang-lun*[32]*),* acting as a fly-wheel.

Spinning — *fang-sha*[33]
To twist together and draw out fibres into a continuous yarn.

Spinning silk — *fang-ssu*[34], *nien-mien*[3S], *fang-mien-ssu*[3f]>
To bind together fibres of normally irregular length from waste silk after degumming.

[1] 綜 [2] 綜眼 [3] 綜日 [4] 綜框 [5] 綜片
[6] 瓦 [7] 繀 [8] 紡緯 [9] 軠 [10] 筧
[11] 甕 [12] 車 [13] 掉甕 [14] 繅 [15] 治
[16] 紡條 [17] 絞絲 [18] 嫘子 [19] 嫘子 [20] 條子
[21] 紗條 [22] 梳條 [23] 錠 [24] 筵 [25] 莞
[26] 手紡錠 [27] 軸 [28] 木桿 [29] 鍋 [30] 紡塼
[31] 紡錘 [32] 紡輪 [33] 紡紗 [34] 紡絲 [35] 撚綿
[36] 紡綿絲

Splicing *chi', chhi*[2]
The various splicing techniques applied in the processing of bast fibres. They make use of the natural properties of the material, namely the gums and pectins. By splicing the fibres of usually irregular length a continuous yarn is obtained suitable for spinning.

Spool *yü-thungi, yü-tzu* [4]
Thread-bearing device placed on the spindle.

Spooling Same as winding.

Thread See yarn.

Throwing *lo ssu*[5]*, tiao ssu*[6]*, phao ssu*[1]*, nien ssu*[s]
1. The twisting together of several single yarns into one thread in a direction opposite to that in which they themselves are twisted.
2. To give a single thread a twist.

Treadle-operated loom *chiao-tha-chi"*
A loom in which the raising or lowering of the heddles is operated by treadles and not by hand.

Twisting *yao'°, ckia-nien*[1]*'*
To **put into** the **component(s)** of **a yarn or thread a spiral composition** which is normally the result of rotation.
S-twist (left-spun), Z-twist (right-spun).

Waste silk *fei-ssu'*[2]
Fibres obtained from damaged or unreelable cocoons.

Winding *chi*[3]*, thai*[1]**, lo sha*[5]*, chiian-jao*[6]*, tiao ssu*[6]
To transfer thread from a reel to a spindle, spool or bobbin in order to process the thread further.

Yarn, thread *hsien'*[1]*, sha'*, lü">*
In modern textile technology, yarn and thread are usually defined in a way which makes no sense in this context. So simplified definitions have to be given: yarn is the product of spinning fibres, **with or** without a twist. Thread is the product of reeling together a number of baves. It is also the result of twisting together in one or more operations two or more single yarns.

[1] 績 [2] 紕 [3] 綿筒 [4] 綿子 [5] 絡絲
[6] 調絲 [7] 拋絲 [8] 拈絲 [9] 腳踏機 [10] 搖
[11] 加拈 [12] 廢絲 [13] 給 [14] 紿 [15] 絡紗
[16] 卷繞 [17] 綫 [18] 紗 [19] 纓

BIBLIOGRAPHIES

A CHINESE AND JAPANESE BOOKS AND ARTICLES BEFORE + 1912

B CHINESE AND JAPANESE BOOKS AND JOURNAL ARTICLES SINCE + 1912

C BOOKS AND JOURNAL ARTICLES IN WESTERN LANGUAGES

When obsolete or unusual romanisations of Chinese words occur in entries in Bibliography C, they are followed, wherever possible, by the romanisations adopted as standard in the present work. If inserted in the title, these are enclosed in square brackets; if they follow it, in round brackets. When Chinese words or phrases occur romanised according to the Wade-Giles system or related systems, they are assimilated to the system here adopted (cf. Vol. i, p. 26) without indication of any change. Additional notes are added in round brackets. The reference numbers do not necessarily begin with (1), nor are they necessarily consecutive, because only those references required for this volume of the series are given.

Korean and Vietnamese books and papers are included in Bibliographies A and B. As explained in Vol. 1, pp. 21 ff., reference numbers in italics imply that the work is in one or other of the East Asian languages.

ABBREVIATIONS OF WESTERN JOURNALS

A	*Archaeology*
AA	*Arts Asiatiques*
AH	*Agricultural History*
AM	*Asia Major*
APS	*Anthropos*
APVVV	*Alt-Preussen. Vierteljahresschrift für Vorgeschichte und Volkskunde*
ARLC	*Annual Reports of the Librarian of Congress*
AS	*Anatolian Studies*
BGSC	*Bulletin of the Geological Survey of China*
BGTI	*Beiträge für Geschichte der Technik und Industrie*
BL	*Bulletin de Liaison. Centre International d'Etude des Textiles Anciens*
BM	*Burlington Magazine*
BMFEA	*Museum of Far Eastern Antiquities. Bulletin*
BZ	*Byzantinische Zuschrift*
CR	*Ciba-Review*
CRe	*Chinese Repository*
CRu	*Ciba-Rundschau*
cue	*Cooper Union. Chronicle of the Museum for the Arts & Decoration*
DWAWIPH	*Denkschriften d. Akad. d. Wissensch. Wien* (Vienna): *Phil. Hist. Kl.*
EC	*Early China*
EcB	*Economic Botany*
FL	*Folk Liv*
GHA	*Göteborg Hogskolos Arsskrift*
GR	*Geographical Review*
G TIG	*Geschichtsblätter für Technik, Industrie und Handel*
HJAS	*Harvard Journal of Asiatic Studies*
HT	*History of Technology*
JA	*Journal Asiatique*
JAOS	*Journal of the American Oriental Society*
JESHO	*Journal of the Economic and Social History of the Orient*
JÖAI	*Jahreshefte des österreichischen Archäologischen Institutes*
JRGZM	*Jahrbuch des Römisch-Germanischen Z^{m}-tralmuseums Mainz*
MCB	*Melanges Chinois et Bouddhiques*
MMA	*Malmö Museum arsberättelse*
MMAB	*The Metropolitan Museum of Art Bulletin*
MS	*Monumenta Serica*
MSOS	*Mitteilungen d. Sem. f. Orient. Sprachen (Berlin)*
OA	*Oriental Art*
OL	*Orientalistische Literaturzeitung*
OZ	*Ostasiatische Zuschrift*
PMHB	*Peking Natural History Bulletin*
QJLC	*Quarterly Journal of the Library of Congress*
RS A J	*Royal Society of Arts Journal*
RTM	*Rayon Textile Monthly*
S	*Speculum*
SB	*Sandoz Bulletin*
SIAR	*Smithsonian Institution. Annual Report*
SWAWIPH	*Sitzungsber. d. preuss. Akad. d. Wissenschaften: Phil. Hist. Kl.*
TG	*Technikgeschichte*
TH	*Textile History*
TP	*T'oung Pao*
VBGAEU	*Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*
WC	*World Crops*
YM	*ïouth Monthly*
ZDMG	*Zeitschrift der Deutschen Morgenländischen Gesellschaft*
ZE	*Zeitschrift für Ethnologie*
ZV	*Zeitschrift für Vorgeschichte*

ABBREVIATIONS OF CHINESE AND JAPANESE JOURNALS

ccrc	*Ching Chi Ten Chiu* 經濟研究
CKKHP	*Chung-Kuo Khao Ku Hsüeh Pao* 中國考古學報
CKNS	*Chung-Kuo Nung Shih* 中國農史
CWHP	*Chih Wu Hsüeh Pao* 植物學報
FJHC	*Fu-Jen Hsüeh Chih* 輔人學志
JMHP	*Jen Min Hua Pao* 人民畫報
HPNHYHP	*Hsi-Pei Nung Hsüeh Yüan Hsüeh Pao* 西北農學院學報
HTFCKHYHP	*Hua-Tung Fang Chih Kung Hsüeh Yüan Hsüeh Pao* 華東紡織工學院學報
KCHP	*Kung Chheng Hsüeh Pao* 工程學報
KHSCK	*Kho Hsüeh Shih Chi Khan* 科學史集刊
KK	*Khao Ku* 考古
KKChK	*Ku-Kung Chou Khan* 故宮週琛
KKCK	*Ku-Kung Chi Khan* 故宮集刊
KKHP	*Khao Ku Hsüeh Pao* 考古學報
KKPWYYK	*Ku-Kung Po Wu Yüan Yüan Khan* 故宮博物院院刊
KKTH	*Khao Ku Thung Hsün* 考古通訓
KKyWW	*Khao Kuyü Wen Wu* 考古與文物
KSK	*Kodai Shi Kôza* 古代史講座
KTY	*Kiangsu Tshan Yeh* 江蘇蠶業
LSYC	*Li Shih Yen Chiu* 歷史研究

MTTC	*Min Tsu Thuan Chieh* 民族團結
NS£	*Nihon Sanshigaku £asshi* 日本蚕糸学雜誌
NYKK	*Nung Yeh Kao Ku* 農業考古
QBCBjC	*Quarterly Bulletin of Chinese Bibliography* (Chinese Edition) *Thu Shu Chi Khan* 圖書季刊
SH	*Shih Huo* 食貨
SHHK	*Shih Hsüeh Hui Khan* 史學彙刊
SSHK	*Sanshi Shikenjâ Hôkoku* 蚕糸試験場報告
TBKK	*Tôyô Bunka Kenkyûjo Kiyô* 東洋文化研究所紀要
TFTC	*Tung Fang Tsa Chih* 東方雜誌
TG	*Tâhâ Gakuhâ* 東方学報
TLTC	*Ta Lu Tsa Chih* 大陸雜誌
TSTK	*Tshan Ssu Tshung Khan* 蠶絲叢刊
TSTP	*Tshan Sang Thung Pao* 蠶桑通報
TYKH	*Tshan Yeh Kho Hsüeh* 蠶業科學
WW	*Wen Wu* 文物
WWTT	*Wen Wu Thien Ti* 文物天地
WWTLTK	*Wen Wu Tzu Liao Tshung Khan* 文物資料叢刊

ABBREVIATIONS OF CHINESE AND JAPANESE BOOK COLLECTIONS, TSHUNG-SHU, SERIES & PUBLISHERS

CCTTS	*Chhing Chao Thang Tshung Shu* 青照堂叢書
CHSC	*Chung-Hua Shu-Chii* 中華書局
CHTSCC	*Chih Hsüeh Tshung Shu Chhu Chi* 質學叢書初集
CHTSTK	*Chien Hsi Tshun She Tshung Khan* 漸西村舍叢刊
CHTTS	*Ching Hsiin Thang Tshung Shu* 經訓堂叢書
CLHP	*Chi Lu Hui Pien* 紀錄彙編
CPTCTS	*Chih Pu Tsu Chai Tshung Shu* 知不足齋叢書
CSTtC	*Cheng Shih Tshung Kho* 鄭氏叢刻
CTCC	*Chu Tzu Chi Chheng* 諸子集成
CTMS	*Chin Tai Mi Shu* 津逮祕書
EKKS	*Edo Kagaku Koten Sôsho* 江戶科學古典叢書
HCCC	*Huang Chhing Ching Chieh* 皇清經解
HCCSWP	*Huang Chhao Ching Shih Wen Pien* 皇朝經世文編
HCTY	*Hsüeh Chin Thao Yuan* 學津討原
HH	*Han Hai* 函海
HHLP	*Hsüeh Hai Lei Pien* 學海類編
HNWCK	*Hai-Ning Wang Chung-Kho Kung I Shu* 海寧王忠慤公遺書
HWTS	*Han_ Wei Tshung Shu* 漢魏叢書
IMKT	*I Men Kuang Tu* 夷門廣牘
KCTS	*Kuan Chung Tshung Shu* 關中叢書
KCTSCC	*Ku Chin Thu Shu Chi Chheng* 古今圖書集成
KOCTS	*Ko Chih Tshung Shu* 格致叢書
KWSC	*Kuang- Wen Shu-Chü* 廣文書局
LSSC	*Li Shih San Chung* 李氏三種
MHCH	*Mo Hai Chin Hu* 墨海金壺
MSTS	*Mei Shu Tshung Shu* 美術叢書
NHTS	*Nung Hsüeh Tshung Shu* 農學叢書
MKKZ	*Nihon Kagaku Koten £ensho* 日本科学古典全書
PLHS	*Pai Ling Hsüeh Shan* 百陵學山
PPTS	*Pai Pu Tshung Shu* 百部叢書
PSLC	*Phu Sung-Ling Chi* 蒲松齡集
PYTMC	*Pao Yen Thang Mi Chi* 寶顏堂秘笈
SCSC	*Shih-Chieh Shu-Chü* 世界書局
SF	*Shuo Fu* 說郛
SHCKTS	*Shanghai Chhang Ku Tshung Shu Ti I Chi* 上海掌故叢書第一集
SPPY	*Ssu Pu Pei Yao* 四部備要
SPTK	*Ssu Pu Tshung Khan* 四部叢刊
SSCCS	*Shih San Ching Chu Sh* 十三經注疏
STTSKHC	*Shan Tso Tshan Sang Khao Hou Chi* 山左蠶桑改後記
THCTSP	*Thung Hsüeh Chai Tshung Shu Pen* 通學齋叢書本
TNKTS	*Tai Nan Ko Tshung Shu* 岱南閣叢書
TSCC	*Tshung Shu Chi Chheng* 叢書集成
WHCPS	*Wen Hai Chhu Pan She* 文海出版社
WHST	*Wen Hsing Shu Tien* 文星書店
WYWK	*Wan Yu Wen Khu* 萬有文庫
YCTS	*Yung-Chia Tshung Shu* 永嘉叢書
YHSFCIS	*Yü Han Shan Fang Chi I Shu* 玉函山房輯佚書
YLTT	*Yung-Lo Ta Tien* 永樂大典

A. CHINESE AND JAPANESE BOOKS AND ARTICLES BEFORE +1912

Each entry gives particulars in the following order:

(a) title, alphabetically arranged, with characters;
(b) alternative title, if any;
(c) translation of title;
(d) cross-reference to closely related book, if any;
(e) dynasty;
(f) date as accurate as possible;
(g) name of author or editor, with characters;
(A) title of other book, if the text of the work now exists only incorporated therein; or, in special cases, references to sinological studies of it;
(i) references to translations, if any, given by the name of the translator in Bibliography C;
(j) notice of any index or concordance to the book if such a work exists;
(k) reference to the number of the book in the *Tao Tsang* catalogue of Wieger (6), if applicable;
{l) reference to the number of the book in the *San Tsang* (Tripitaka) catalogues of Nanjio (i) and Takakusu & Watanabe, if applicable.

Words which assist in the translation of titles are added in round brackets.

Alternative titles or explanatory additions to the titles are added in square brackets.

Where there are any differences between the entries in these bibliographies and those in Vols. 1-5, the information here given is to be taken as more correct.

An interim list of references to the editions used in the present work, and to the *tshung-shu* collections in which books are available, has been given in Vol. 4, pt. 3, pp. 913 ff., and is available as a separate brochure.

ABBREVIATIONS

C/Han	Former Han.
E/Wei	Eastern Wei.
H/Han	Later Han.
H/Shu	Later Shu (Wu Tai).
H/Thang	Later Thang (Wu Tai).
H/Chin	Later Chin (Wu Tai).
S/Han	Southern Han (Wu Tai).
S/Phing	Southern Phing (Wu Tai).
J/Chin	Jüchen Chin.
L/Sung	Liu Sung.
N/Chou	Northern Chou.
N/Chhi	Northern Chhi.
N/Sung	Northern Sung (before the removal of the capital toHangchou).
N/Wei	Northern Wei.
S/Chhi	Southern Chhi.
S/Sung	Southern Sung (after the removal of the capital to Hangchou).
W/Wei	Western Wei.

Chhang Chung Sang Shu Hsi 倡種桑樹檄
Introducing the Planting of the Mulberry Trees.
Chhing, + 1757.
Chhen Hung-Mou 陳宏謀
HCCSWP, ch. 37.

Chhang-Hsing-Hsien Chih 長興縣志
Local Gazetteer of Chhang-Hsing-Hsien.
Chhing, + 1892 (rev. ed. of + 1874).
Chao Ting-Pang 趙定邦

Chhi Min Tao Shu 齊民要術
Important Arts for the People's Welfare.
N/Wei, +533 to +544,
Chia Ssu-Hsieh 賈思勰
CHTSTK.
See, des Rotours (1),
Shih Sheng-Han (_j),
Shih Sheng-Han (9),
Li Chhang-Nien (3).
A complete translation of the *CM TS* by Francesca Bray is available in the East Asian History of Science Library, Cambridge.

Chhieh Tun 切韻
Dictionary of the Sounds of Characters (rhyming dictionary).
Sui, +601.
Lu Fa-Yen 陸法言
See *Kuang Tun.*

Chhin Ting Hsü Wen Hsien Thung Khao 欽定續文獻通考
Imperially Commissioned Continuation of the Comprehensive Study of (the History of) Civilisation (cf. *Wen Hsien Thung Khao* and *Hsü Wen Hsien Thung Khao).*
Chhing, ordered + 1747, printed + 1772 (+ 1784).
Chhi Shao-Nan 齊召南, Chi Huang 嵇璜 (eds.).

Chhin Ting Ssu Khu Chhilan Shu Tsung Mu Thi Tao 欽定四庫全書總目提要
Analytical Catalogue of the Books in the *Ssu Khu Chhiian Shu* Encyclopaedia, made by imperial order.
Chhing, + 1782.
Ed. Chi Yiin 紀昀
Repr. Shanghai 1934.
Indexes by Yang Chia-Lo; Yü and Gillis, Yin-Te Index, no. 7.

Chhing Shih Kao 清史稿
History of the Chhing Dynasty [+ 1644 to + 1911].
Republic, 1928.
Chao Erh-Sun 趙爾巽 *et al.*
CHSC, Peking 1976.

Chho Keng Lu 輟耕錄
Talks (at South Village) while the Plough is Resting.
Yuan, + 1366.
Thao Tsung-I 陶宗儀
SCSC.

Chhu Hsiieh Chi 初學記
Guide to Knowledge for Beginners.
Thang, + 700.
Hsü Chien 徐堅

Chhu Hsüeh Chi (cont.)
CHSC, Peking 1980.
Chhun Chhiu 春秋
Spring and Autumn Annals.
Chou; a chronicle of the State of Lu kept between — 722 and —481.
Writers unknown.
Cf. Tso Chuan; Kung-Yang Chuan; Ku-Liang Chuan.
Chhun Chhiu Khao I Tu 春秋考異郵
Apogryphical Treatise on the *Chhun Chhiu.*
Writers unknown.
Chhun Chhiu Tso Chuan Cheng I 春秋左傳正義
Orthodox Interpretation of the Spring and Autumn Annals (*c.* — 722 to —481, a Chronicle of the State of Lu) and Master Tso's Tradition (— 722 to —453).
Chin & Thang.
Annotated by Tu Yü 杜預 (Chin) and Khung Ying-Ta 孔穎達 (Thang).
SSCCS.
See *Tso Chuan.*
Chhü Hsien Shen Tin 臞仙神隱
Divine Secrets of Chhü Hsien.
Ming, + 1408.
Chu Chhüan 朱權
KOCTS.
Chhüan Chung Sang Hsi 勸種桑檄
Encouraging the Planting of Mulberry Trees.
Chhing, + 1751.
Chhen Hung-Mou 陳宏謀
HCCSWP, ch. 37.
Chhüan Hsiang Min Chung Sang Shuo San Tse 勸襄民種桑說三則
Discussing the Three Rules Encouraging and Assisting People to Plant the Mulberry Tree.
Chhing, late + 18th century to before + 1826.
Chou Khai 周凱
HCCSWP, ch. 37.
Chhün Fang Phu 群芳譜
Botanical Treatise.
Ming, + 1621.
Wang Hsiang-Chin 王象晉
Chi Chiu Phien 急就篇
Dictionary of Urgent Use; Handy Primer [orthography word-lists intended for verbal exposition, connected with a continuous thread of text, and having some rhyme arrangements].
C/Han, between —48 and —33.
Shih Yu 史游
With + 7th cent, commentary by Yen Shih-Ku 顏師古 and + 13th cent, commentary by Wang Ying-Lin 王應麟
CTMS, Shanghai 1922.
Chi Pei Shu 吉貝疏
Monograph on Cotton.
Ming, + 17th century.
Hsü Kuang-Chhi 徐光啓
(The original monograph no longer survives, but was probably incorporated into the *NCCS.)*
Chia-Hsing-Fu Chih 嘉興府志
Local Gazetteer of Chia-Hsing-Fu.
Chhing, +1878.
Hsü Yao-Kuang 許謠光 *et al.*
Chiao-Chou I Wu Chih 交州異物志
See, *I Wu Chih.*
Chiao Tshan 教蠶
Teaching Sericulture.
Chhing, + 17th century.
Thang Chen 唐甄
HCCSWP, ch. 37.
Chih Wu Ming Shih Thu Khao Chhang Pien. 植物名實圖考長編
An Illustrated Collection of Materials from Various Sources on the Names and Reality of Plants.
Chhing, the original ed. may be dated to + 1846, later ed. of + 1870.
Wu Chhi-Chün 吳其濬
Repr. Shanghai 1959.
Chin Shu 晉書
History of the Chin Dynasty [+ 265 to + 420].
Thang, +635.
Fang Hsüan-Ling 房玄齡
A few ch. trs. Pfizmaier (54—57).
Chiu Thang Shu 舊唐書
Old History of the Thang Dynasty [+ 618 to + 906].
Wu Tai, +945.
Liu Hsü 劉昫
CHSC, Peking 1975.
Cf. des Rotours (2), p. 64.
For translations of passages see the index of Frankel (1).
Chou I Cheng I 周易正義
The Orthodox Interpretation of the Chou Book of Changes.
Thang.
Khung Ying-Ta 孔穎達 (+ 574 to + 648).
SPPT.
Chou Li 周禮
Record of the Institutions (lit. Rites) of the Chou Dynasty (Descriptions of All Government Posts and Their Duties).
Former Han, some material from late Chou.
Compilers unknown.
Tr. E. Biot (1).
Chou Li Chu Shu 周禮注疏
The Chou Li with Assembled Commentaries.
Han and Thang.
Cheng Yuan 鄭元 (Han).
Chia Kung-Yen 賈公彥 (Thang).
SSCCS.
Chuang Tzu 莊子
The Book of Master Chuang.
Chou, *c.* —290.
Chuang Chou 莊周
Quoted from *Chuang Tzu Pu Cheng* 莊子補正
Annotated and Corrected Text of Chuang Tzu.
Ed. of 1939.
Chung Chu Ma Fa 種苧麻法
The Methods of Growing Ramie and Hemp.

Chung Chu Ma Fa (cont.)
Chhing, printed + 1901.
Huang Hou-Yü 黃厚裕
Chung Mien Hua Fa 種棉花法
Cotton Growing.
Ming, + 17th century.
Hsii Kuang-Chhi 徐光啓
See *Chi Pet Shu.*
Chung Mien Shuo 種棉說
Talk about the Planting of Cotton.
Chhing.
Li Pa 李拔
HCCSWP, ch. 37.
Chung Sang Shih Shuo 種桑詩說
Discussions of Poems about Planting Mulberries.
Chhing, late + 18th century, before + 1826.
Chou Khai 周凱
HCCSWP, ch. 37.
Chung Shih Chih Shuo 種蒔直說
Plain Speaking on Planting.
Original title of the *Han Shih Chih Shuo* 韓氏直說
Chung Shu Shu 種樹書
The Book of Treeplanting.
Ming, *c.* + 1390.
Yü Chen-Mu 俞貞木 (Yü Tsung-Pen 俞宗本)
IMKT,
Chit Chia Pi Yung Shih Lei Chhüan Chi 居家必用事類全集
Collection of Certain Sorts of Techniques Necessary for Households (Encyclopaedia).
Ming, + 1560.
prob. Hsiung Tsung-Li 熊宗立
Thienju-Chheng 田汝成 (ed.).
SKCS.
Partly repr. in Shinoda Osamu & Tanaka Seiichi (/).

Erh Ya 爾雅
The Literary Expositor [dictionary!.
Chou material, stabilised in Chhin and Han times.
Enlarged and commented on *c.* + 300 by Kuo Pho 郭璞
Yin-Te Index no. (suppl.) 18.
Erh Ya I 爾雅翼
Assisting Notes to the *Erh Ya* Dictionary.
Sung, + 1174.
Lo Yuan 羅願
HCTY.

Fan Sheng-Chih Shu 氾勝之書
The Treatise of Mr Fan Sheng-Chih on Agriculture.
C/Han, —37 to —7.
Fan Sheng-Chih 氾勝之
Quoted in the *CMYS.*
YHSFCIS, ch. 69.
Tr. Shih Sheng-Han (5).
Fang Chih Chih Li 紡織之利
Advantages of Spinning and Weaving.
Chhing, probably between + 1670 and + 1682.
Ku Yen-Wu 顧炎武
HCCSWP, ch. 37.
Fang Yen 方言
Dictionary of Local Expressions.
C/Han, *c.* — 15 (but much later matter interpolated).
Yang Hsiung 楊雄
HWTS.
Fang Yen Su Cheng 方言疏證
Annotated and Amplified Text of the *Fang Yen.*
Chhing, + 1777.
Tai Chen 戴震

Hat- Yen-Hsien Chih 海鹽縣志
Gazetteer of Hai-Yen-Hsien.
Chhing, +1876-7.
Wang Pin 王彬
Hei Ta Shih Lueh 黑韃事略
Summary of Records on the Tatars.
Sung, + 1237.
Pheng Ta-Ya 彭大雅
HNWCK, 1927.
Han Shih Chih Shuo 韓氏直說
Plain Speaking by Mr Han.
Sung or Chin, + 12th or + 13th century.
Author unknown.
Lost work, partly contained in the *NSCY 2tnA* in the *NCCS.*
Hou Han Shu 後漢書
History of the Later Han Dynasty [+ 25 to + 220].
L/Sung, +450.
Fan Yeh 范曄
CHSC; Peking 1973.
The monograph chapters by Ssu-Ma Piao 司馬彪 (d. +305), with commentary by Liu Chao 劉昭 *(c.* +570), who first incorporated them into the work.
A few ch. trs. Chavannes (6, 16); Pfizmaier (52, 53)-
Yin-Te Index, no. 41.
Hsi Ching Tsa Chi 西京雜記
Miscellaneous Records of the Western Capital.
Liang or Chhen, mid + 6th century.
Attrib. to Liu Hsin 劉歆 (C/Han) or Ko Hung 葛洪 (Chin), but probably from Wu Chün 吳均 (Liang).
HWTS.
See, Elfie Heeren-Diekhoff (1).
Hsi Han Hui Yao 西漢會要
History of the Administrative Statutes of the Former (Western) Han Dynasty.
Sung, + 1211.
Ed. Hsü Thien-Lin 徐天麟
Cf. Teng & BiggerstafT(i), p. 158.
Hsi Wu Tshan Liieh 西吳蠶略
Summary of Sericulture in West Kiangsu.
Chhing, +1845.
Chheng Tai-An 程岱葊
(In the Peking Thu Shu Kuan).

Hsin Hsiu Pen Tskao 新修本草
The New (lit. Newly Improved) Pharmacopoeia.
Thang, +659.
(Ed.) Su Ching (= Su Kung) 蘇敬 (蘇恭) and a commission of 22 collaborators under the direction first of Li Chi 李勣 and Yü Chih-Ning 于志寧, then of Chhang-Sun Wu-Chi 長孫無忌. This work was afterwards commonly but incorrectly known as *Thang Pen Tshao.* It was lost in China, apart from MS fragments at Tunhuang, but copied by a Japanese in +731 and preserved in Japan though incompletely.

Hsin Pien Ku Lieh NU Chuan 新編古列女傳
Newly Compiled Biographies of Famous Women in Ancient China.
Sung, + 1214.
Tshai Chi 蔡驥
Printed by the Yü ^ family printing-house in Chien-An 建安, Fukien province.

Hsin Thang Shu 新唐書
New History of the Thang Dynasty [+ 618 to + 906].
Sung, + 1061.
Ou-Yang Hsiu 歐陽修 & Sung Chhi 宋祁
CHSC, Peking 1975.
Partial trs. des Rotours (1, 2); Pfizmaier (66—74). For translations of passages see the index of Frankel (1).
Yin-Te Index, no. 16.

Hsü Shih Shih 續事始
Continuation of the Beginnings of Things.
H/Shu, *c.* +960.
Ma Chien 馬鑑
SF, ch. 10.

Hsü Thung Chih 續通志
The Historical Collections Continued (see *Thung Chih)* [to the end of the Ming Dynasty].
Chhing, commissioned + 1767, pr. *c.* + 1770.
Ed. Chi Huang ^$t(*al*.

Hsü-Wen-Hsien Shih Xeh Tiao Chha Kai Lüeh 徐聞縣實業調查概略
A General Account of an Investigation into the Industries of Hsü-Wen District.
Chhing, + 1904.
Ho Ping-Hsiu 何炳修

Hsü Wen Hsien Thung Khao 續文獻通考
Continuation of the Comprehensive Study of (the History of) Civilisation (cf. *Wen Hsien Thung Khao* and *Chhin Ting Hsü Wen Hsien Thung Khao).*
Ming, +1586, pr. +1603.
Ed. Wang Chhi 王圻

Hsün Tzu 荀子
The Book of Master Hsün.
Chou, *c.* —240.
Hsün Chhing 荀卿
CTCC, vol. 2.
Tr. Dubs (7).

Hu-Chheng Pei Khao 滬城備考
An Appendix for Reference to Hu-Chheng.
Chhing, early + 19th century.
Chhu Hua 褚華
SHCKTS.

Hu Tshan Shu 湖蠶述
The Story of Sericulture in Hu-Chou.
Chhing, + 1874.
Wang Yüeh-Chen 汪曰楨
Repr., Peking 1956.

Huai Hai Chhang Tuan Chü 淮海長短句
The Collected Works of Chhin Kuan.
Ming, +1539.
Collated by Chang Yen 張綖
SPTK.

Huai Nan Tzu 淮南子
The Book of (the Prince of) Huai-Nan [compendium of natural philosophy].
C/Han, *c.* —120.
Written by the group of scholars gathered by Liu An 劉安, Prince of Huai-Nan.
SPPT.
Partial trs. Morgan (1); Erkes (1); Hughes (1); Chatley (1); Wieger (2).
Chung-Fa Index, no. 5.

Huai-Nan- Wang Tang Tshan Ching 淮南王養蠶經
The Book of Rearing Silkworms in the Tradition of Huai-Nan.
Northern Sung or earlier.
Author unknown.
Lost work.

Huan Tu Thung Chih 寰宇通志
Geography and Topography of the Empire.
Ming, + 1456.
Chhen Hsün 陳循
KWSC, Taipei 1968.

Huang Chhao Ching Shih Wen Pien 皇朝經世文編
Collection of Essays and Other Writings, a Kind of Guide to Government.
Chhing, + 1826; printed + 1827.
Ho Chhang-Ling 賀長齡

Huang Chhing Ching Chieh 皇清經解
Collection of (more than 180) Monographs on Classical Subjects Written during the Chhing Dynasty.
Chhing, + 1829.
Yen Chieh 嚴杰 (ed.).
2nd. ed. + i860.

Hui-Lai-Hsien Chih 惠來縣志
Local Gazetteer of Hui-Lai-Hsien.
Chhing, + 1732.
Chang Shao-Mei 張玿美

Hyakunin JorB 百人女郎
One Hundred Women.
Edo period, + 1723, published in Kyoto.
Nishikawa Sukenobu 西川祐信

I Wen Lei Chü 藝文類聚
A Classified Collection of Literary Productions.
Thang, +624.
Ou-Yang Hsün 歐陽詢
Repr. Shanghai 1982.

I Wu Chih 異物志
Record of Strange Things in Chiao-Chou [mod. Annam].

I Wu Chih (conl.)
H/Han, *c.* +90.
Yang Fu 楊孚
Extant in quotations, see *TSCC.*

Keng Chih Thu 耕織圖
Pictures of Tilling and Weaving.
Sung, presented in MS, + 1145, and perhaps first printed from wood blocks at that time; engraved on stone, + 1210, and probably then printed from wood blocks.
Lou Shou 樓璹
The illustrations published by Franke (11) are those of + 1462 and + 1739?; Pelliot (24) published a set based on an edition of + 1237. Fuchs (8) Franke (11, 14) Kuhn (2). The edition of the Yung-cheng J$i JE reign period is pictured in *KKCHK* 193a, 144, 56; 1933, 244—83. The original illustrations are lost, but cannot have differed much from these last, which include the poems of Lou Shou. The first Chhing edition was in + 1696.

Keng Chih Thu Shih 耕織圖詩
Poems and Pictures of Tilling and Weaving.
Sung, +1145.
Lou Shou 樓璹

Keng Sang Chih Sheng Tao Pei 耕桑治生要備
Manual of Important Preparations which have to be Done to Make a Living from Agriculture and Sericulture.
Sung, + 1127; preface from + 1153.
Ho Hsien-Chüeh 何先覺
Lost work.

Khang-Hsi Tzu Tien 康熙字典
Imperial Dictionary of the Khang-Hsi Reign Period.
Chhing, + 1716.
Chang Yü-Shu 張玉書 (ed.).
CHSC, repr. Hong Kong 1973.

Khao Rung Chi Thu 考工記圖
Illustrations of the Artificers' Record (of the *Chou Li)* (with a critical archaeological analysis).
Chhing, + 1746.
Tai Chen 戴震
HCCC, chs. 563-4.

Kishoku Ihen 機織彙編
Compendium on Looms.
Edo period, + 1830.
Öseki Masunari 大閔增業
EKKS, vol. 15.
Meissner (1).

Ko Wu Tshu Than 格物粗談
Simple Discourses on the Investigation of Affairs and Things.
Sung, *c.* + 980.
Attrib. wrongly to Su Shih 蘇軾, actual writer (Lu) Tsan-Ning (錄)贊寧
HHLP.

Kogai Kinu Furui Taisei 蚕飼絹篩大成
Complete Work on Sericultural Arts.
Edo period, +1815.
Text by Narita Jüpei Shisai 成田重兵衛思齋
111. by Koyama Hikobei Kanrei 小山彥兵衛寬嶺
EKKS, vol. 14.

Ku Chin Thu Shu Chi Chheng 古今圖書集成
Imperial Encyclopaedia [or: Imperially Commissioned Compendium of Literature and Illustrations, Ancient and Modern].
Chhing, + 1726.
Ed. Chhen Meng-Lei 陳夢雷
Repr. *WHST,* Taipei 1964.
Index L. Giles (2).

Ku Lieh Nu Chuan 古列女傳
Biographies of Famous Women in Ancient China.
C/Han, -79 to -8.
Attr. to Liu Hsiang 劉向
Repr. of a Sung edition by Juan Fu 阮福 in + 1825, the ill. are by his sister Chi-Lan 季蘭

Kuan Tzu 管子
The Writings of Master Kuan.
Chou and C/Han.
Attr. to Kuan Chung 管仲
CTCC.
Part. trs. Maverick (1).
Haloun (2, 5).

Kuang Chih 廣志
Extensive Records of Remarkable Things.
Chin, late + 5th century.
Kuo I-Kung 郭義恭
THSFCIS, ch. 74.

Kuang-Chou Chi 廣州記
Records of Kuang-Chou.
San Kuo, *c.* +220.
Ku Wei 顧微

Kuang Hsing Shan Tshan Hsi 廣行山蠶檄
Report on the Widespread Wild Silkworm.
Chhing, +1757.
Chhen Hung-Mou 陳宏謀
HCCSWP, ch. 37.

Kuang Tshan Sang Shuo 廣蠶桑說
Broad Explanations on Sericulture.
Chhing, printed + 1863.
Shen Lien 沈練
(This edition was not available to us.)

Kuang Tshan Sang Shuo Chi Pu 廣蠶桑說輯補
Supplemented Edition of the *Broader Explanations on Sericulture.*
Chhing, + 1875.
Chung Hsiieh-Lu 仲學輅
PPTS.

Kuang Ta 廣雅
Enlargement of the *Erh Ta; Literary Expositor* [dictionary].
San Kuo (Wei), +230.
Chang I 張揖

Kuang Ta Su Cheng 廣雅疏證
Annotated and Amplified Text of the *Kuang Ta.*
Chhing, + 1796.
Wang Nien-Sun 王念孫, completed by Wang Yin-Chih 王引之

Kuang Tun 廣韻
Revision and Enlargement of the *Dictionary of Characters Arranged according to Their Sounds when Split* [rhyming phonetic dictionary based on, and including, the *Chhieh Tun* and the *Thang Tun*, q.v.]
Sung, + ion.
Chhen Pheng-Nien 陳彭年, Chhiu Yung 丘雍 *etal.*
Teng & Biggerstaff (i), p. 203.

Li Chi 禮記
[= *Hsiao Tai Li Chi]*
Record of Rites [compiled by Tai the Younger] (cf. *Ta Tai Li Chi).*
Ascr. C/Han, *c.* —70/ —50,
but really H/Han, between +80 and + 105, though the earliest pieces included may date from the time of the *Analects (c.* —465/ —4.50).
Attrib. ed. Tai Sheng 戴聖
Actual ed. Tshao Pao 曹褒
Trs. Legge (7); Couvreur (3); R. Wilhelm (6).
Yin-Te Index, no. 27.

Li Chi Cheng I 禮記正義
The Orthodox Interpretation of the *Li Chi.*
Thang.
Khung Ying-Ta 孔穎達 (+ 514 to + 648).
SSCCS.

Liang Shu 梁書
History of the Liang Dynasty [+ 502 to + 556].
Thang, +629.
Yao Chha 姚察 and Yao Ssu-Lien 姚思廉
CHSC, Peking 1973.

Lieh Tzu 列子
The Book of Master Lieh.
Chou and C/Han, —5th to — ist centuries.
Ancient fragments of miscellaneous origin finally cemented together with much new material about + 380.
Attrib. Lieh Yü-Khou 列禦寇
Shih-te-tang ed., 1914.

Lin Chhuan Wen Chi 臨川文集
The Collected Works of Wang An-Shih.
Sung, + 1140.
WTWK.

Ling Piao Lu I 嶺表錄異
Strange Southern Ways of Men and Things [on the special characteristics and natural history of Kuangtung].
Thang & Wu Tai, between *c.* +895 and +915.
Liu Hsün 劉恂

Ling Wai Tai Ta 嶺外代答
Instead of Replies to Friends and Acquaintances about the South-western Regions beyond the Mountain-passes.
Sung, + 1178.
Chou Chhü-Fei 周去非
TSCC.
Tr. Netolitzky (1).

Lu Shih 路史
A History of China from High Antiquity to the Eastern Han Dynasty.
Sung, + 1170.
LoPi 羅泌
SPPT.

Lü Shih Chhun Chhiu 呂氏春秋
Master Lü's Spring and Autumn Annals [compendium of natural philosophy].
Chou (Chhin), —239.
Written by the group of scholars gathered by Lü Pu-Wei 呂不韋
SPTK.
Tr. R.Wilhelm (3).
Chung-Fa Index, no. 2.

Lun Tu 論語
Conversations and Discourses (of Confucius) [perhaps Discussed Sayings, Normative Sayings, or Selected Sayings]; Analects.
Chou (Lu), *c.* —465 to —450.
Compiled by disciples of Confucius (chs. 16, 17, 18 and 20 are later interpolations).
Tr. Legge (2); Lyall (2); Waley (5).
Yin-Te Index, no. (suppl.) 16.

Mao Shih Tshao Mu JViao Shou Chhung Tu Shu 毛詩草木鳥獸蟲魚疏
Commentary on Botanical and Zoological Terms in the Mao-edition of the *Shih-Ching.*
San Kuo (Wu), +3rd. century *c.* +245.
Lu Chi 陸璣
TSCC.

Mien Hua Thu 棉花圖
Illustrations of Cotton Planting and Manufacture.
See *Tii~ Thi Mien Hua Thu.*

Mien Teh Thu Shuo 棉業圖說
Illustrated Account of Textile Production.
Chhing, + 1911.
Ministry of Agriculture, Industry and Trade.
8 vols.

Min Chhan Lu I 閩產錄異
Strange Facts Recorded about the Products of Fukien.
Chhing, +1886.
Kuo Pai-Tshang 郭柏蒼

Min Pu Shu 閩部疏
Commentaries on Fukien.
Ming, *c.* +1585.
Wang Shih-Mou 王世懋
CLHP.

Ming Shih 明史
History of the Ming Dynasty [+ 1368 to + 1644].
Chhing, begun + 1646, completed + 1736 first pr- +I739-
Chang Thing-Yü 張廷玉 *et al.*
CHSC, Peking 1974.

Mo Tzu 墨子
The Book of Master Mo.
Chou, —4th century.
Mo Ti 墨翟 (and disciples).
CTCC, vol. 4.
Tr. Forke (3), Schmidt-Glintzer (1).
Yin-Te Index, no. (suppl.) 21.

Morokoshi Kinmö £ui 唐土訓蒙圖彙
Illustrated Encyclopaedia on China and Her People.
Edo period, + 1719 in Osaka.
Tachibana Morikuni 栖原守國

Mu Mien Phu 木棉譜
Treatise on Cotton.
Chhing, early + 19th century.
Chhu Hua 褚華
TSCC.

Nan Chhi Shu 南齊書
History of the Southern Chhi Dynasty [+ 479 to + 502].
Liang, +520.
Hsiao Tzu-Hsien 蕭子顯
CHSC, Peking 1972.
For translations of passages see the index of Frankel (1).

Man Chou I Wu Chih 南州異物志
Record of Strange Things from the Southern Regions.
San Kuo or Chin, between +270 and +310.
Wan Chen 萬震
Extant only in quotations.

Nan Fang I Wu Chih 南方異物志
= *Nan Chou I Wu Chih* (Wan Chen).
The latter is the correct title.
In the Thang and Sung periods, there circulated a work with the present title by Fang Chhien-Li 房千里 but it does not exist in full now.

Nan Fang Tshan Shu 南方蠶書
The Silkworm Treatise of the Southern Regions.
Date and author unknown; quoted in the *NS.*

Nan Fang Tshao Mu Chuang 南方草木狀
Appearances of Plants and Trees in the Southern Regions.
Chin, +304.
Attr. wrongly to Chi Han 嵇含. The work is most probably a compilation of Sung times, see Ma Tai-Loi (1).
TSCC.
Tr. Li Hui-Lin (11).

Nan Fang Tshao Wu Chuang 南方草物狀
A Prospect of the Plants and Products of the Southern Regions.
Chin, + 3rd or +4th.
Hsü Chung 徐衷
Extant only in quotations, esp. in *Chhi Min Tao Shu.*

Nan Tiieh Pi Chi 南越筆記
Miscellaneous Notes from Kuangtung Made while Travelling.
Chhing + 1777 or later.
Li Thiao-Yüan 李調元
HH.

Ning-Kuo-Fu Chih 寧國府志
Local Gazetteer of Ning-Kuo-Fu.
Chhing, +1815.
Lu Chhüan 魯銓
Repr. 1919.

Nung Cheng Chhüan Shu 農政全書
Complete Treatise on Agriculture.
Ming, composed + 1625-8, printed + 1639.
Hsü Kuang-Chhi *fâ % Jgp;* ed. Chhen Tzu-Lung 陳子龍
Textual refs. are to the + 1843 repr. of the Palace ed.; a new annotated ed. was published in Shanghai in 1979 by Shih Sheng-Han (5).

Nung Chhi Phu 農器譜
Treatise on Agricultural Implements.
Sung, + 1 ith century.
Tseng Chih-Chin 曾之謹
Preface by Chou Pi-Ta 周必大
Lost work.

Nung Li 農曆
Almanac of Agriculture.
Sung, + 1 ith century.
Teng Yii-Fu 鄧御夫 (d. +1107).
Lost work.

Nung Sang Chi Tao 農桑輯要
Compilation on Agriculture and Sericulture.
Yuan, + 1273.
Preface by Wang Phan 王磐. Imperially commissioned, & produced by the Agricultural Extension Bureau 司農司
Probable editor, Meng Chhi 孟祺. Probable later editors, Chhang Shih-Wen *(c.* + 1286) 暢師文, Miao Hao-Chhien *(c.* + 1318) 苗好謙
SPPT.
Shih Sheng-Han (//).

Nung Sang Chi Tao 農桑輯要
Compilation on Agriculture and Sericulture.
Ming.
Yüju-Chieh 俞汝楫
Lost work.

Nung Sang Chih Shuo 農桑直說
Plain Speaking on Agriculture and Sericulture.
Sung or Chin, + 12th or + 13th century.
Author unknown.
A lost work, partly preserved in the *NS* and in the *NCCS.*

Nung Sang Ching 農桑經
Book on Agriculture and Sericulture.
Chhing, *c.* + 1705.
Phu Sung-Ling 蒲松齡
PSLC.
Li Chhang-Nien (5).

Nung Sang I Chih Lu 農桑易知錄
Record of Easy Knowledge about Agriculture.
Chhing, printed + 1741.
Cheng Chih-Chhiao 鄭之橋
CSTK.

Nung Sang I Shih Tsho Tao 農桑衣食撮要
Selection on Agriculture, Sericulture, Clothing & Food.
Yuan, *c.* + 1314.
Ed. Lu Ming-Shan (Uighur) 魯明善
MHCH.

Nung Sang Tsho Tao 農桑撮要
Selections from Agriculture and Sericulture.
Chin or Yuan.
Lo Wen-Chen 羅文振

Nung Sang Tsho Tao (cont.)
Lost work.

Nung Shu 農書
Book on Agriculture.
Sung, 2nd. half of + 12th century.
Preface by Hsieh O 謝諤 (d. + 11.94)-
Lost work.

Nung Shu 農書
Book on Agriculture.
Sung, + 12th century
Liu Chhing-Chih 劉清之
Lost work.

Nung Shu 農書
Book on Agriculture.
Sung, + 1149.
Chhen Fu 陳旉
CPTCTS.
MuChhi-Yü(2).
Wan Kuo-Ting (6").

Nung Shu 農書
Book on Agriculture.
Yuan, + 1313.
Wang Chen 王禎
Editions consulted: + 1530-ed. in 36 eh., contained in the *PPTS* 27:38; +]774-ed., completed in + 1783, in 22 ch.
Nung-shu reprints in modern typeset; Peking, 1956, Taipei, 1965.
WangYü-Hu 王毓瑚 (if).

Nii Chieh 女誡
Lessons for Women.
H/Han, + 1st cent.
Pan Chao 班昭

Pai Hu Thung Te Lun 白虎通德論
Comprehensive Discussions at the White Tiger Lodge.
H/Han, *c.* +80.
Pan Ku 班固
SPTK.

Pet Thong Shu Chhao 北堂書鈔
Book Records of the Northern Hall [encyclopaedia].
Thang, *c.* +630.
Yü Shih-Nan 虞世南
Edition of + 1888; repr. *WHCPS,* Taipei 1962.

Pen Tshao Kang Mu 本草綱目
The Great Pharmacopoeia; or, The Pandects of Pharmaceutical Natural History.
Ming, +1596.
Li Shih-Chen 李時珍
Paraphrased and abridged tr. Read & collaborators (1-7) and Read & Pak (1), with indexes.
Repr. Shanghai 1930; 1959.

Pen Tshao Thu Ching 本草圖經
Illustrated Pharmacopoeia; or, Illustrated Treatise of Pharmaceutical Natural History.
Sung, + 1061.
Su Sung 蘇頌 *et al.*
Now preserved only in numerous quotations in the later pandects of pharmaceutical natural history.

Phing-Hu-Hsien Chih 平湖縣志
Gazetteer of Phing-Hu-Hsien.
Chhing, +1886.
Pheng Jun-Chang 彭潤章

Pien Min Thu Tsuan 便民圖纂
Collection of Pictures for Ordinary People.
Ming, +1593.
The author could be Kuang Fan 廣璠.
Repr. Peking 1959; Taipei 1975.
Shih Sheng-Han & Khang Chheng-I (/).

Pien Tung Hsüeh Hai Chhiin Yii 便用學海群玉
Seas of Knowledge and Mines of Jade; Encyclopaedia for Convenient Use.
Ming, + 1607.
Compiler unknown.
Ed. Wu Wei Tzu 武緯子

Pin Feng Kuang I 豳風廣義
Enlarged Explanations of the Sericultural Crafts of Pin.
Chhing, +1740-2.
Yang Shen 楊屾
Repr. Shanghai i960; *KCTS,* Taipei 1970, vol. 18.

Pu Nung Shu 補農書
The *Nung Shu* Amended.
Ming, *c.* + 1620.
Chang Lü-Hsiang 張履祥
Tr. into modern Chinese in Chhen Heng-Li & Wang Ta-Tshan (/), 251-80.
Repr. as *Shen Shih Nung Shu* (Mr Shen's Nung Shu). Peking 1956.

San Fu Huang Thu 三輔黃圖
Illustrated Description of the Three Districts in the Capital (Chhang-An (mod. Sian), Feng-I and Fu-Teng).
Chin, original text late + 3rd century, or perhaps H/Han; present version stabilised, including much older material, between + 757 and +907.
Attr. Miao Chhang-Yen 苗昌言
SPTK.
Chhen Chih (/).
Cf. des Rotours (1), p. lxxxvi.

San Nung Chi 三農記
Record of the Three Departments of Agriculture.
Chhing, preface + 1760.
Chang Tsung-Fa 張宗法

San Tshai Thu Hui 三才圖會
Universal Encyclopaedia.
Ming, + 1609.
Wang Chhi 王圻
Repr. Taipei 1970.

Sang Chih 桑志
Record of Mulberry.
Chhing, + 18th century.
Li Yü-Chhiu 李聿求
LSSC.

Sei Katsu Roku 製葛錄
Record on the Processing of the Kuzu-Vine.
Edo period, + 1828.

Sei Katsu Roku (cont.)
Okura Nagatsune 大藏永常
NKKZ, vol. 6.

Shan Hai Ching 山海經
Classic of the Mountains and Rivers.
Chou and C/Han.
Writers unknown.
CHTTS.
Partial tr. de Rosny (1).
Chung-Fa Index, no. 9.

Shan Tso Tshan Sang Khao 山左蠶桑攷
Investigation into the Sericulture of Shantung Province
Chhing, +1835.
Lu Hsien 陸獻

Shang Shu Cheng I 尙書正義
The Orthodox Interpretation of the *Shang Shu* (Historical Classic).
SSCCS.
See *Shu Ching.*

Shao-Hsing Hsin-Chhang-Hsien Wu Chhan Piao 紹興新昌縣物產表
Table of Products from Hsin-Chhang-Hsien, Shao-Hsing.
Chhing, + 1904.
Writer unknown.

Shih Chi 史記
Record of the Historian (down to —99).
C/Han, *c.* —90.
Ssu-Ma Chhien 司馬遷, and his father Ssu-Ma Than 司馬談
CHSC, Peking 1972.
Partial trs. Chavannes (1) ; Pfizmaier (13-36) ; Hirth (2); Wu Khang (1); Swann (1) etc.
Yin-Te Index, no. 40.

Shih Ching 詩經
Book of Odes [ancient folksongs].
Chou, — 11 th to — 7th centuries (Dobson's dating).
Writers and compilers unknown.
Tr. Legge (8) ; Waley (1) ; Karlgren (14).

Shih Hu Chü Shih Shih Chi 石湖居士詩集
Collection of Poems by the Recluse of the Stone Lake, Fan Chheng-Ta (+ 1126 to +1193).
Chhing, + 1688.
Ku Ssu-Li 顧嗣立 (ed.).
SPTK.

Shih Nung Pi Tung 士農必用
The Farmer's Essentials.
Sung or Chin, + 12th or + 13th century.
Author unknown.
A lost work, partly contained in the *NSCY* and in the *JVS.*

Shih San Ching Chu Shu 十三經注疏
Edition of the Thirteen Classics with Assembled Commentaries, Including the *Shih San Ching Chiao Khan Chi* 十三經校勘記 of + 1806.
Chhing, +1816.
Juan Yuan 阮元
Repr. Shanghai 1980.

Shih Wu Chi Yuan 事物紀原
Record of the Origin of Things.
Sung, *c.* + 1078 to + 1085.
Kao Chheng 高承
TSCC.

Shou I Kuang Hsun 授衣廣訓
Instructions on the Customs during the Year.
Chhing, + 1808.
Author unknown.
Repr. Peking i960.

Shou Shih Thung Khao 授時通考
Complete Investigation of the Works & Days.
Chhing, + 1742.
Compiled by imperial order under the direction ofO-Erh-Thai 鄂爾泰
Textual refs. are to the + 1847 repr. of the original + 1742 Palace ed.

Shu Chin Phu 蜀錦譜
Monograph on the Silk Brocade Industry of Szechwan.
Yuan, + 14th century.
Fei Chu 費著
MSTS.

Shu Ching 書經
Historical Classic [or, Book of Documents].
The 29 'Chin Wen' chapters mainly Chou (a few pieces possibly Shang) ; the 21 'Ku Wen' chapters a 'forgery' by Mei Tse 梅賾, *c.* +320, using fragments of genuine antiquity. Of the former, 13 are considered to go back to the — 10th century, 10 to the —8th, and 6 not before the — 5th. Some scholars accept only 16 or 17 as pre-Confucian.
Writers unknown.
See, Creel (4).
Tr. Medhurst (1); Legge (10); Karlgren (12).

Shu Yuan Tsa Chi 菽園雜記
Miscellaneous Notes on the Vegetable Garden.
Ming, +1494.
LuJung 陸容
TSCC.

Shuo Fu 說郛
Florilegium of (Unofficial) Literature.
Yuan, *c.* + 1368.
Thao Tsung-I 陶宗儀 (ed.).

Shuo Wen Chieh Tzu 說文解字
Analytical Dictionary of Characters (lit. Explanations of Simple Characters and Analysis of Composite Ones).
H/Han, +121.
Hsü Shen 許愼
Chhing ed. of + 1809, repr. Peking 1963.

Sou Shen Chi 搜神記
Legends of the Supernatural.
Chin, +348.
Kan Pao 干寶
HCTY.

Ssu Khu Chhiian Shu Tsung Mu Thi Yao, see *Chhin- Ting Ssu Khu Chhiian Shu Tsung Mu Thi Yao.*

Ssu Min Yiieh Ling 四民月令
Monthly Ordinances for the Four Sorts of People.
H/Han, *c.* + 160.
Tshui Shih 崔寔

Ssu Min Yüeh Ling (cont.)
Tr. Herzer (i).
Wan Kuo-Ting & Mu Chhi-Yü (/).
Ssu Shih Tsuan Yao 四時纂要
Collection of the Essentials of the Four Seasons.
Thang, *c,* +9th or early + 1 oth century.
Compiled Han O 韓鄂
Mu Chhi-Yü (/).
Su-Chou Chih Tsao Chü Chih 蘇州織造局志
Report on the Silk-weaving Workshops of Su-Chou.
Chhing, +1685.
Sun Phei 孫珮
Repr. 1959.
(The work was not available to us.)
Su Tung-Pho Chi 蘇東坡集
The Collected Works of Su Tung-Pho.
Sung, + 1171.
WYWK, Shanghai 1934.
Sui Shu 隋書
History of the Sui Dynasty [+581 to +618].
Thang, +636 (annals and biographies) 1+656 (monographs and bibliography).
Wei Cheng 魏徵 *et al.*
CHSC, Peking 1973.
Partial trs. Pfizmaier (61-65); Balazs (7, 8); Ware(i).
For translations of passages see the index of Frankel (1).
Sung-Chiang-Fu Chih 松江府志
Local Gazetteer of Sung-Chiang-Fu.
Chhing, + 1819.
Sungju-Lin 宋如林
Repr. +1884.
Sung-Chiang-Fu Hsü Chih 松江府續志
The Gazetteer of Sung-Chiang Prefecture (Kiangsu) Continued.
Chhing, pr. +1884.
Pojun-Hsiu 博潤修
Ed. Yao Kuang-Fa 姚光發 *et al.*
Sung Hui Yao Kao 宋會要稿
Draft of Documents Pertaining to Matters of State in the Sung Dynasty.
Sung.
Collected by Hsü Sung 徐松 (+ 1809) from the *Yung-Lo Ta Tien.*
Sung Shih 宋史
History of the Sung Dynasty [+960 to + 1279].
Yuan, *c.* + 1345.
Tho-Tho (Toktaga) ig |ft & Ou-Yang Hsüan 歐陽玄
CHSC, Peking 1977.
Yin-Te Index, no. 34.
Sung Shu 宋書
History of the Sung Dynasty [+420 to +479].
S/Chhi, +500.
Shen Yo 沈約
CHSC, Peking 1974.

Ta Chhing Hui Tien 大清會典
History of the Administrative Statutes of the Chhing Dynasty.
Chhing: ist ed. + 1690; 2nd + 1733; 3rd. + 1767; 4th + 1818; 5th + 1899.
Ed. Wang An-Kuo 王安國 and many others.
Ta Ming Hui Tien 大明會典
Government Administration of the Great Ming Dynasty.
Ming, printed + 1509.
Li Tung-Yang 李東陽
Repr. Taipei 1964.
Ta Ming I Thung Chih 大明一統志
Official Geography of the Ming Empire.
Ming, + 1461.
Li Hsien 李賢
Repr. Taipei 1965.
Ta Tai Li Chi 大戴禮記
Record of Rites [compiled by Tai the Elder.] *[Ci.LiChi).*
C/Han, *c.* —70 to —50 but really H/Han, between +80 and +105.
Attrib. ed. Tai Te 戴德; in fact probably ed. Tshao Pao 曹褒
See Legge (7).
Tr. Douglas (1); R. Wilhelm (6).
Thai-Phing Huan Yü Chi 太平寰宇記
Universal Geography of the Thai-Phing Reign Period [+976 to +983].
Sung, *c.* +980.
Yüeh Shih 樂史
Thai-Phing Yü Lan 太平御覽
Thai-Phing Reign Period Imperial Encyclopaedia (lit. the Emperor's Daily Readings).
Sung, +983.
Ed. Li Fang 李昉
Some chs. tr. Pfizmaier (84-106).
Yin-Te Index, no. 23.
Thang Hui Yao 唐會要
History of the Administrative Statutes of the Thang Dynasty.
Sung, +961.
Wang Phu 王溥
Cf. des Rotours (2), p. 92.
Thang Yiin 唐韻
Thang Dictionary of Characters Arranged according to their Sounds [rhyming phonetic dictionary based on, and including, the *Chhieh Yiin,* q.v.].
Thang, +677, revised and republished +751.
Chhang-Sun No-Yen ft gfc fft 's (+7th) & Sun Mien 孫愐 (+8th).
Now extant only within the *Kuang Yiin,* q.v.
Thiao Hsieh Lei Pien 調燮類編
Systematic Compendium on Harmonising.
Sung, before + 1240.
Chao Hsi-Ku 趙希鵠
TSCC.
Thien Kung Khai Wu 天工開物
The Exploitation of the Works of Nature.
Ming, + 1637.
Sung Ying-Hsing 宋應星
Repr. Peking 1959.
Tr. Sun & Sun (1)
Yabuuchi *(27)*

Thien Kung Khai Wu (cont.)
Li Chhiao-Phing (i)
Chung Kuang-Yen (/).

ThuChing (PenTshao) 圖經(本草).
Illustrated Treatise (of Pharmaceutical Natural History). See *Pen Tshao Thu Ching.*
The term *Thu Ching* applied originally to one of the two illustrated parts (the other being a *Tao Thu)* of the *Hsin Hsiu Pen Tshao* of + 659 (q.v.); cf. *Hsin Thang Shu,* ch. 59, or *KCTSCC, (i-wu),* p.273. By the middle of the + 11 th century these had become lost, so Su Sung's *Pen Tshao Thu Ching* was prepared as a replacement. The name *Thu Ching Pen Tshao* was often afterwards applied to Su Sung's work, but according to the evidence of the *Sung Shih* bibliographies wrongly.

Thung Chhih Chhien-Sheng Chung Hsiang Tu Tshan Hsi 通飭黔省種橡育蠶檄
Circular Instructions about the Planting of the *Quercus sinensis* to Rear Silkworms in Kueichou Province.
Chhing, *c.* + 1825.
Sung Ju-Lin 宋如林
HCCSWP, ch. 37.

Thung ChihfLuehJ 通志[略].
Comprehensive Treaty [Historical Collections].
Sung, *c.* + 1150.
Cheng Chhiao 鄭樵
SPPY.

Thung Su Pien 通俗編
Compilation of Used Synonyms.
Chhing, preface of + 1751.
Compiled by Chai Hao 翟灝

Thung Su Wen 通俗文
Commonly Used Synonyms.
H/Han, + 180.
Fu Chhien 服虔
YHSFCIS.

Thung Tien 通典
Comprehensive Statutes.
Thang, +812.
TuYu 杜佑
wrwK.

Ti Wang Shih Chi 帝王世紀
Records of Generations of Emperors and Kings.
San Kuo or Ghin, *c.* +270.
Huang-Fu Mi 皇甫謐

To Phin 惰貧
Laziness and Poverty.
Chhing, + 17th century.
Thang Chen 唐甄
HCCSWP, ch. 37.

Tsai Sang Thu Shuo 栽桑圖說
Illustrations and Explanations on the Planting of Mulberry Trees.
Yuan, *c.* + 1318.
Miao Hao-Chhien 苗好謙
Lost work.

Tshan Cheng Chai Too 蠶政摘要
Selected Essentials from the Management in Sericulture.
Chhing, + 1756.
Yang Shen 楊屾

Tshan Ching 蠶經
Book on Sericulture.
Thang.
Author unknown.
A lost work in 2 chs.

Tshan Ching 蠶經
Book on Sericulture.
Thang.
Author unknown.
A lost work in 1 ch.

Tshan Ching 蠶經
Book on Sericulture.
Ming.
Huang Hsing-Tseng 黃省曾
PLHS.

Tshan Phu 蠶譜
Treatise on Sericulture.
Ming, late + 16th or early + 17th century.
Hsü Wen-Tsao 許問造
Lost work.

Tshan Sang Chi Tao 蠶桑輯要
Compilation on Sericulture.
Chhing, + 1831.
Kao Chhiian 高銓
An original edition is preserved in the Peking Thu Shu Kuan.

Tshan Sang Chi Tao 蠶桑輯要
Compilation on Sericulture.
Chhing, + 1871; repr. + 1896.
Shen Ping-Chheng 沈秉成

Tshan Sang Chi Tao 蠶桑輯要
Compilation on Sericulture.
Chhing, + 1898 or later.
Cheng Wen-Thung 鄭文同

Tshan Sang Chien Ming Chi Shuo 蠶桑簡明輯說
Simplified Explanation of Sericulture.
Chhing, rev. ed. + 1888.
Huang Shih-Pen 黃世本

Tshan Sang Chien Pien 蠶桑簡編
Short Compilation on Sericulture.
Chhing, + 1829.
Yang Ming-Yang 楊名颺
CCTTS.

Tshan Sang Chih 蠶桑志
Record of Sericulture.
Ming.
Chhen Kho-Jen 陳克任
Lost work.

Tshan Sang Ho Pien 蠶桑合編
The Complete Compilation on Sericulture.
Chhing, + 1843; 2nd. ed. + 1845.
Sha Shih-An 沙式菴
Lu I-Mei 陸伊湄
Wei Mo-Shen 魏默深

Tshan Sang Phu 蠶桑譜
Treatise on Sericulture.
Chhing, + 1873.
Chhen Chhi-Yüan 陳啓源
See, Tshao Theng-Fei (/).

Tshan Sang Shuo g ^ i .

Tshan Sang Shuo (cont.)
Explanations on Sericulture.
Chhing, + 18th century.
Li Pa 李拔
HCCSWP, ch. 37.

Tshan Sang Shuo 蠶桑說
Explanations on Sericulture.
Chhing, before + 1855.
Shen Lien 沈練
(This work was not available to us.)

Tshan Sang Shuo 蠶桑說
Explanations on Sericulture.
Chhing, + 1896 or earlier.
Chao Ching-Ju 趙敬如
CHTSTK.

Tshan Sang Tsa Chi 蠶桑雜記
Miscellanies on Sericulture.
Chhing, probably early + 19th century.
Chhen Pin 陳斌
STTSKHC.

Tshan Sang Tshui Pien 蠶桑萃編
General Compendium on Sericulture.
Chhing, + 1899.
Wei Chieh 衛杰
Repr. Peking 1956.

Tshan Shih Tao Liteh 蠶事要略
Summary of Sericultural Matters.
Chhing.
Chang Hsing-Fu 張行孚
CHTSTK.

Tshan Shu 蠶書
Book on Sericulture.
Sung, + 1 oth century.
Sun Kuang-Hsien 孫光憲
Lost work, partly quoted in the *NS.*

Tshan Shu 蠶書
Treatise on Sericulture.
Sung, *c.* + 1090.
Chhin Kuan 秦觀
TSCC.

Tshan Shuo 蠶說
Explorations on Sericulture.
Chhing, + 18th century.
Wang Jung-Hsü 王榮緒
Lost work.

Tshan Wu Shuo Liieh 蠶務說略
Brief Explanation of Sericulture.
Chhing, + 1897.
Khang Fa-Ta 康發達 (F. Kleinwächter) (ed.).
CHTSCC.

Tso Chuan 左傳
Master Tso-Chhiu's Tradition (or Enlargement) of the *Chhun Chhiu (Spring and Autumn Annals)* [dealing with the period — 722 to —453].
Late Chou, compiled from ancient written and oral traditions of several states between —430 and — 250, but with additions and changes by Confucian scholars of the Chhin and Han, especially Liu Hsin. Greatest of the three commentaries on the *Chhun Chhiu,* the others being the *Kung- Tang Chuan* and the *Ku-Liang Chuan,* but unlike them, probably originally itself an independent book of history.
Attrib. Tso-Chhiu Ming 左邱明
See Karlgren (8); Maspero (1); Wu Khang (1); Van der Loon (1).
Tr. Couvreur (1); Legge (11); Pfizmaier (1-12). Eberhard, Müller & Henseling (1).
Index by Fraser & Lockhart (1).

Tsuan Wen 纂文
Lexicography.
+ 5th century.
Ho Chheng-Thien 何承天

Tung Ching Meng Hua Lu 東京夢華錄
Dreams of the Glories of the Eastern Capital.
Sung, first printed + 1187.
Attr. to Meng Yüan-Lao 孟元老
TSCC.

Tzu Chih Thung Chien 資治通鑑
Comprehensive Mirror for Aid in Government.
Sung, + 1065, completed + 1084.
Ssu-Ma Kuang 司馬光
Commentaries by Hu San-Hsing 胡三省 (2nd half + 13th cent. Yuan).
CHSC, Peking 1956.
Cf. des Rotours (2), p. 74; Pulleyblank (7).

Tzu Chih Thung Chien Wai Chi 資治通鑑外紀
Additional Chronicle to the Comprehensive Mirror for Aid in Government.
Sung, +1078.
Liu Shu 劉恕
SCSC, Shanghai 1935.

Tzu Jen I Chih 梓人遺制
Traditions of the Joiners' Craft.
Yuan, + 1264.
Hsüeh Ching-Shih 薛景石
TLTT, ch. 18245.
Tr. Kuhn (3).

Wan Tung Cheng Tsung Pu Chhiu Jen Chhiian Pien 萬用正宗不求人全編
The Ask No Question Complete Handbook for General Use.
Ming, +1609.
Yü Wen-Thai 余文台

Wei Shu 魏書
History of the (Northern) Wei Dynasty [+ 386 to +550].
N/Chhi, +554, rev. ed. +572.
Wei Shou 魏收
CHSC, Peking 1974.

Wen Hsien Thung Khao 文獻通考
General Investigations on Important Writings.
Yuan, begun perhaps as early as + 1270 and was finished *c.* + 1280, not published before + 1319, printed +1322.
Ma Tuan-Lin 馬端臨
WTWK, Shanghai 1936.
Cf. des Rotours (2), p. 87.
A few chs. tr. Julien (2); d'Hervey St Denys (1).

Wen Hsüan 文選
General Anthology of Prose and Verse.
Liang, +53°-

Wen Hsiian (cont.)
Hsiao Thung 蕭統 (prince of the Liang).
Comm. Li Shan 李善, *c.* + 670.
SPTK.
Tr. von Zach (6); Knechtges (1).

Wu Chä Pa Chin 五車拔錦
Excerpts from the Collections of Books.
Ming, +1597.
Hsü San-Yu 徐三友
Printed by Cheng Shih-Khuei 鄭世魁

Wu Lei Hsiang Kan Chih 物類相感志
Record of Mutual Interaction of Things.
Sung, before + 1102.
Attr. to Su Shih 蘇軾
PYTMC.

Wu Pen Chih Ten 務本直言
Plain Speaking about Attending to the Fundamentals in Agriculture and Sericulture.
Sung or Chin, + 13th century or earlier.
Hsiu Thing-I 修廷益
Lost work quoted in the *JVS.*

Wu Pen Hsin Shu 務本新書
The New Book Attending to the Fundamentals of Agriculture.
Chin, *c.* middle of + 13th century.
Author unknown.
Lost work, quoted in the *NSCY.*

lang Tshan Chheng Fa 養蠶成法
The Perfect Method of Rearing Silkworms.
Chhing, + 18th century.
Han Meng-Chou 韓夢周
XHTS.

Tang Tshan Mi Chieh 養蠶秘訣
Secrets of Silkworm Breeding.
Chhing, *c.* + 1875 to + 1908.
Chang Wen-I 張文藝
THCTSP.

Teh Tshan Lu 野蠶錄
Record on Wild Silkspinners.
Chhing, preface of + 1902.
Wang Yüan-Yen 王元綖

Ten Thieh Lun 鹽鐵論
Discourses on Salt and Iron (Record of the Debate of —81 on State Control of Commerce and Industry).
C/Han, -80.
Huan Khuan 桓寬
Cf. Gale (0.

Ten-Tüan Tai H sien Sheng Wen Chi 剡源戴先生文集
Collected Works of Tai Piao-Yüan (+ 1244 to + 1310).
Ming, + 1371.
Preface by Sung Lien 宋濂
SPTK.

Ten-Tüan Wen Chi 剡源文集
See *Ten- Tüan Tai Hsien Sheng Wen Chi.*

TSsan Hiroku 養蠶秘錄
'Secret Record' of Sericulture.
Edo period, preface of + 1802, printed 1803.
Preface by Sakurai Atsutada 櫻井篤忠
111. by Hökyo Nishimura Chüwa 法橋西村中和
EKKS, vol. 13.

Tung-Chia-Chün Chi 永嘉郡記
Records of Yung-Chia Prefecture.
L/Sung, *c.* +420 to +477.
Cheng Chi-Chih 鄭緝之
A version reconstructed from fragments is published in *TCTS.*

Tung-Lo Ta Tien 永樂大典
Great Encyclopaedia of the Yung-Lo Reign Period [only in manuscript].
Amounting to 22,877 chapters in 11,095 volumes, only about 370 still being extant.
Ming, + 1407.
Ed. Hsieh Chin 解縉
Repr. Peking i960; Taipei 1962.

Tu Hai 玉海
Ocean of Jade [encyclopaedia].
Sung, + 1267, not pr. till + 1337/ + 1340 or + I35I-
Wang Ying-Lin 王應麟
Cf. des Rotours (2), p. 96.

Tu Phien 玉篇
Jade Page Dictionary.
Liang, +543.
Ku Yeh-Wang 顧野王, extended and enlarged in +674 by Sun Chhiang 孫强

Til- Thi Mien Hua Thu 御題棉花圖
Illustrations of Cotton Planting and Manufacture.
Chhing, + 1765.
Fang Kuan-Chheng 方觀承

Yuan-Feng Chiu Tii Chih 元豐九域志
Topography of the Nine Regions in the Reign Period of Yüan-Feng (+ 1078 to + 1085).
Wang Tshun 王存
Tseng Chao 曾肇
Li Te-Chhu 李德芻
TSCC.

Tiian-Ho Chiin Hsien Thu Chih 元和郡縣圖志
Topography of the Prefectures and Districts of China in the Reign Period Yiian-Ho (+ 806 to + 820).
Thang, + 9th century.
Li Chi-Fu 李吉甫
TNKTS.

Tüan Shih 元史
History of the Yuan (Mongol) Dynasty [+ 1206 to +1367].
Ming, *c.* + 1370.
Sung Lien 宋濂
CHSC, Peking 1976.

Tüan Tien Chang 元典章
Institutions of the Yuan Dynasty.
Sung Fen Shih Tsl 誦芬室叢刋 ed.

Tüeh Ling Kuang I 月令廣義
Enlarged Explanations to the Seasons.
Ming, + 1601.
Feng Ying-Ching 馮應京

Yiieh Ling Shih 月令釋
Explanation to the Seasons.

Thang, ist. half of the +8th century.
Li Lin-Fu 李林甫
Quoted in *Wen Hsien Thung Khao.*

Yiieh Ling Thung Khao 月令通考
General Investigation on the Works of the Seasons.
Ming, +1589.
Lu Han 盧翰

ADDENDA TO BIBLIOGRAPHY A

Anhui Chhiian Pan Tso Tshan An 安徽勸辦柞蠶案
Plans to Encourage the Raising of Wild Silkworms [Tussah Silk Spinner] in Anhui Province.
Chhing, + 1910.
Ed. Thung Hsiang-Hsiung 童祥熊

Chiao Chung Shan Tshan Phu 教種山蠶譜
Treatise on the Rearing of Mountain Silkworms.
Chhing, + 1894.
Cheng Chen 鄭珍

Chung Sang Tang Tshan Chheng Fa 種桑養蠶成法
The Complete Method of Planting Mulberry Trees and Rearing Silkworms.
Chhing, + 1867.
Author unknown.

Nong Lin Tshan Shuo 農林蠶說
Discussions on Farming, Forestry and Sericulture.
Chhing, + 1911.
Yeh Hsiang-Jung 葉向榮

Pien Chi Tshan Sang Chien Ming Thu Shuo 編輯蠶桑簡明圖說
Compilation with Concise Illustrations and Explanations on Sericulture.
Early 20th century.
Author unknown.

Shan Tshan Ti Chien 山蠶易簡
Simple and Brief Explanations on Mountain Silkworms.
Chhing, +1884.
Chi Chih 績芝

Tshan Sang Chi Yao 蠶桑輯要
Compilation on Sericulture.
Chhing, + 1862.
Chheng Ping-Ang 程炳昂

Tshan Sang Chien Fa 蠶桑簡法
Simple Explanations of the Methods of Sericulture.
Chhing, + 1910.
Chhen Hsüeh-Thang 陳雪堂
Preface by Thung Hsiang-Hsiung 童祥熊

Tshan Sang Chien Yao Lu 蠶桑簡要錄
Brief Essentials of Sericulture.
Chhing, + 1902.
Ed. Jao Tun-Chih 饒敦秩

Tshan Sang Pei Lan 蠶桑備覽
Perfect Understanding of Sericulture.
Chhing, +1881.
Chang Chung-Fu 張仲府

Tshan Sang Shih Chi 蠶桑實濟
The Real Advantage of Sericulture.
Chhing, +1884.
Author unknown.

Tshan Sang Shuo Liieh 蠶桑說略
Summary of Sericultural Matters.
Chhing, probably late + 19th century.
Tsung Ching-Fan 宗景藩

Tshan Sang Shuo 蠶桑說
Explanations on Sericulture.
Chhing, + 1890.
Shen Chhing-Chhü 沈清渠

Tshan Sang Ta Wen 蠶桑答問
Questions on Sericulture Answered.
Chhing, + 1901.
Ed. Chu Tsu-Jung 朱祖榮

Tshan Sang Ta Wen Thi Yao 蠶桑答問提要
Summary of Questions on Sericulture Answered.
Chhing, probably after + 1901.
Ed. Chu Tsu-Jung 朱祖榮

Tso Tshan Chien Fa 柞蠶簡法
Simple Explanations of the Methods of Raising Wild Silkworms [Tussah Silk Spinners].
Chhing, probably c. + 1910.
Ed. Hsü Lan 徐瀾

Tso Tshan Chien Fa Pu Yi 柞蠶簡法補遺
Addendum to Simple Explanations of the Methods of Raising Wild Silkworms [Tussah Silk Spinners].
Chhing, + 1910.
Ed. Hsü Lan 徐瀾
Preface by Thung Hsiang-Hsiung 童祥熊

Tso Tshan Hui Chih 柞蠶彙誌
Report on Wild SilkwormsfTussah Silk Spinners].
Chhing, + 1910.
Tseng Yün 增韞

Tso Tshan Tsa Chih 柞蠶雜誌
Journal on Wild Silkworms.
Chhing, + 1906.
Tseng Yün 增韞

B. CHINESE AND JAPANESE BOOKS AND JOURNAL ARTICLES SINCE +1912

Amano Motonosuke *(4)* 天野元之助
Chügoku Nögyöshi Kenkyü 中国農業史研究
Research into the History of Chinese Agriculture.
Tokyo, 1962. 2nd. expanded ed. 1979.

Amano Motonosuke *(8)* 天野元之助
Chügoku JVögaku Shoroku 中国農学書録
Annotated Bibliography of Chinese Agricultural1 Works.
Ryukei Press, Tokyo, 1975. Reprint of Wang Yii-hu (/), *Chung-Kuo JVung-Hsüeh Stm-Lu,* Peking, 1964.

Amano Motonosuke (9) 天野元之助
Chügoku Konôsho Ko 中国古農書考
Investigation of Old Agricultural Works of China.
Ryukei Press, Tokyo, 1975.

Amano Motonosuke *(12)* 天野元之助
"Nösö Shüyö" to Mensaku no Tenkai 「農業輯要」と棉作の展開
On Cotton Cultivation of China and the *Nung Sang Chi Tao.*
TG 東方学報
37:1 (1954). PP- i-45;37:2 (i954)>PP- 199-232:37:3 (1954). PP- 330-60.

Amano Motonosuke *(13)* 天野元之助
Gen no ö Jö "Nösho" no Kenkyü 元の王禎「農書」の研究
The Treatise on Agriculture by Wang Chen of the Yuan Dynasty.
Yabuuchi Kiyoshi (ed.) *(26)* 藪内清
So Gen Jidai no Kagaku Gijutsu Shi 宋元時代の科学技術史
Science and Technology in the Sung and Yuan Period.
Kyoto, 1967, pp. 341-468.

An Chih-Min (5) 安志民
ig^2 JVien Chhiu-Chi Cheng-Chou Erh-Li-Kang Fa-Chiieh Chi 一九五二年秋季鄭州二里岡發掘記
Report on the Excavation of Erh-Li-Kang, Cheng-Chou in Autumn 1952.
KKHP(i954), 8, pp. 65-107.

An Chih-Min *(6)* 安志民
Lüeh-Lun Wo-Kuo Hsin-Shih-Chhi Shih- Tai Wen-Hua ti Nien- Tai Wen- Thi 略論我新石器時代的年代問題
Problems Concerning the Dating of Neolithic Cultural Sites.
KK (1972), 6, pp. 40-1.

Anon. (//).
Chhang-Sha Fa-Chüeh Pao-Kao 長沙發掘報告
Report on the Excavations at Chhang-Sha.
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院考古研究所 (ed.), Kho-Hsüeh, Peking, 1957.

Anon. *(log).*
Chung-Kuo Kao- Teng Chih- Wu Thu-Chien 中國高等植物圖鑒
Iconographia Cormophytorum Sinicorum.
Chung-Kuo Kho-Hsüeh-Yüan Chih-Wu Yen-Chiu-So 中國科學院植物研究所 (ed.), Kho-Hsüeh, Peking, 1972-6, 5 vols.

Anon. *(504).*
Ho-Mu-Tu I-Chih Ti-I-Chhi Fa-Chüeh Pao-Kao 河姆渡遺址第一期發掘報告
First Season's Excavations at Ho-Mu-Tu in Yü-Yao County, Chekiang Province.
Ä"A7ff(i978),i,pp. 39-94.

Anon. *(511).*
Kuangtung Chhü-Chiang Shih-Hsia Mu- Tsang Fa-Chüeh Chien-Pao 廣東曲江石峽墓葬發掘簡報
Excavation of the Neolithic Tomb at Shih-Hsia in Chhü-Chiang County, Kuangtung Province.
WW (1978), 7, pp. 1-22.

Anon. *(512).*
Han Thong Pi-Hua 漢唐壁畫
Murals from the Han to the Thang Dynasty.
Foreign Language Press.
(ed.), Peking, 1974.

Anon. *(531).*
Chung-Kuo Ku-Tai Nung-Yeh Kho-Chi 中國古代農業科技
Agricultural Technology in Ancient China.
Nung-Yeh Chhu-Pan-She 農業出版社 (ed.), Peking, 1980.

Anon. *(536).*
Ma-Lei Tsai-Phei 麻類栽培
The Cultivation of Fibre-crops.
Nung-Yeh, Peking 1962.

Anon. *(537).*
Mien-Hua 棉花
Cotton.
Kho-Hsüeh, Peking 1977.

Anon. *(53g).*
Kansu Tung-Ching Ta-Ho-Chuang I-Chih Fa-Chüeh Pao-Kao 甘肅永靖大河庄遺址發掘報告
Excavations of the Remains of Chhi-Chia Culture at Ta-Ho-Chuang in Yung-Ching County, Kansu Province.
07/P(i974),2,pp. 29-61.

Anon. (600).
Anhui Hsiao-Hsien Hua-Chia-Ssu Hsin-Shih-Chhi Shih-Tai I-Chih 安徽肖縣花家寺新石器時代遺址

Anon. *{600) {cont.)*
The Neolithic Site of Hua-Chia-Ssu, Hsiao County, Anhui.
/^(1966),8, pp. 55-62.

Anon. (60/).
Chhang-Hai-Hsien Kuang-Lu- Tao Ta-Chhang-Shan-Tao Pei-Chhiu I-Chih 長海縣廣鹿島大長山島貝丘遺址
The Shell-mound Sites on Kuang-Lu and Ta-Chhang-Shan Islands in Chhang-Hai County.
KKHP {1^1), 1, pp. 63-110.

Anon. *(602).*
Chhang-Sha Chhu-Mu Po-Hua 長沙楚墓帛畫
The Silk Banner Painting from a Chhu Tomb at Chhang-Sha.
Hunan-Sheng Po-Wu-Kuan 湖南省博物館 (ed.), Wen-Wu, Peking, 1973.

Anon. *(603).*
Chhang-Sha Liu-Chheng-Chhiao I-Hao Mu 長沙劉城橋一號墓
Tomb no. 1 of Liu-Chheng Bridge in Chhang-Sha.
KKHP (1972), 1, pp. 59-72.

Anon. *(604).*
Chung-Kuo Khao-Ku-Hsüeh Chunq Than Shih-Ssu Nien- Tai-Shu Chü-Chi 中國考古學中碳十四年代數據集, 1965-1981-
Radiocarbon Dating in Chinese Archaeology.
Chung-Kuo She-Hui Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So (ed.), Wen-Wu, Peking 1983-

Anon. (605).
Chhang-Sha Ma- Wang- Tui I-Hao Han-Mu 長沙馬王堆一號漢墓
The Han Tomb no. 1 at Ma-Wang-Tui, Chhang-Sha.
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院考古研究所 (ed.), Wen-Wu, Peking, 1973.

Anon. *(606).*
Chhang-Sha Ma- Wang- Tui I-Hao Han-Mu Chhu-Thu Fang-Chih-Phin ti Yen-Chiu 長沙馬王堆一號漢墓出土紡織品的研究
A Study of the Textile Fabrics Unearthed from the Tomb no. 1 at Ma-Wang-Tui, Chhang-Sha.
Shanghai-Shih Fang-Chih Kho-Hsüeh Yen-Chiu-Yüan 上海市紡織科學研究院
Shanghai-Shih Ssu-Chhou Kung-Yeh Kung-Ssu 上海市絲綢工業公司 (eds.), Wen-Wu, Peking, 1980.

Anon. (607).
Chhang-Sha Ma- Wang- Tui I-Hao Han-Mu Chhu-Thu ti Jung-Chhüan-Chin 長沙馬王堆一號漢墓出土的絨圈錦
The Pile-loop Brocade Unearthed from the Han Tomb no. 1 at Ma-Wang-Tui in Chhang-Sha.
KKHP (1974), 1, pp. 175-87, pis. 1-2.

Anon. *(608).*
Chhang-Sha Tang- Thien-Hu Ti 25 *Hao Mu-Kuo-Mu* 長沙仰天湖第25號木槨墓
The Wooden-coffin Tomb no. 25 of Yang-Thien-Hu, Chhang-Sha.
**///> (1957)', a, pp. 85-93.

Anon. *{6og).*
Chekiang-Sheng Yü-Tsu Wen-Wu Tiao-Chha-Chi 浙江省畲族文物調查記
Investigation Report on the Cultural Relics of the Yü Tribe in Chekiang.
WW (i960), 6, pp. 74-7.

Anon. *(610).*
Cheng-Chou Kho-Ka Wanq-Tshun I-Chih Fa-Chiieh Pao-Kao 鄭州旭畣王村遺址發掘報告
Excavation Report from the Site of Kho-Ka Wang-Tshun, Cheng-Chou.
/f/f///> (1958), 3, pp. 1-92.

Anon. *(611).*
Cheng-Chou Hsi-Chiao Yang-Shao Wen-Hua I-Chih Fa-Chiieh Chien-Pao 鄭州西郊仰韶文化遺址發掘簡報
Excavation Report on a Yang-shao Cultural Site in the Western Suburb of Cheng-Chou.
AX77/(i9$_5$8),a,pp. 1-5.

Anon. *{612).*
Cheng-Chou Man-Kuan- Wai Shang- Tai I-Chih ti Fa-Chiieh 鄭州南關外商代遺址的發掘
Excavation of the Shang Site Outside the South Gate of Cheng-Chou.
ÀXHP (1973), 1, pp. 65-92.

Anon. *{613).*
Cheng-Chou Shang- Tai I-Chih ti Fa-Chiieh 鄭州商代遺址的發掘
Excavations of the Remains of the Shang Dynasty at Cheng-Chou, Honan.
KKHP {1957), 1, PP- 53-73-

Anon. *{614).*
Cheng-Chou Ta-Ho-Tshun Yang-Shao Wen-Hua ti Fang-Chi I-Chih 鄭州大河村仰韶文化的房基遺址
The Yang-shao Dwelling Remains at Ta-Ho-Tshun, Cheng-Chou.
**"(i973)>^{6}>PP-33°-^{6}-

Anon. (5/5).
Chheng- Tu Chhing- Yang-Kung I-Chih Shih-Chiieh Chien-Pao 成都青羊宮遺址試掘簡報
Trial Diggings at the Site of Chhing-Yang-Kung, Chheng-Tu, Szechwan.
^(1959),8, pp. 411-18.

Anon. *{616).*
Chheng- Tu Pai-Hua- Than Chung-Hsüeh Shih-Hao Mu Fa-Chiieh-Chi 成都百花潭中學十號墓發掘記
Excavation of Tomb no. 10 of the Warring States Period at the Pai-Hua-Than Middle School in Chheng-Tu, Szechwan Province.
WW (1976), 3, pp. 40-6, pi. 2.

Anon. *{617).*
Kirin Chiang-Pei Thu-Chheng- Tzu Ku- Wen-Hua /-Chih chi Shih-Kuan-Mu 吉林江北土城子古文化遺址及石棺墓
An Ancient Cultural Site and Stone Coffin Tomb of Thu-Chheng-Tzu, Chiang-Pei, Kirin.
KKHP (1957), 1, pp. 43-52.

Anon. *(618).*
Kirin Hsi- Thuan-Shan Skik-Kuan-Mu Fa-Chüeh Pao-Kao 吉林西團山石棺墓發掘報告
Excavations of Cist Tombs at Hsi-Thuan Hill, Kirin.
KKHP (1964), 1, pp. 39-49.

Anon. *(6ig)*
Chia-Yü-Kuan Han-Tai Hua-Hsiang Chuan-Mu 嘉峪關漢代畫像磚墓
The Brick Tomb Paintings of the Han Period at Chia-Yü-Kuan, Kansu Province.
WW (1972), ia, pp. 24-41.

Anon. *(620).*
Kiangsi Chhing-Chiang Ting-Phan-Li I-Chih Fa-Chiieh Pao-Kao 江西清江營盤里遺址發掘報告
Report on the Excavation of the Ying-Phan-Li Site in Chhing-Chiang, Kiangsi.
KK (1962), 4, pp. 172-81.

Anon. *(621)*
Kiangsi Hsiu-Shui Shan-Pei Ti-Chhü Khao-Ku Tiao-Chhayü Shih-Chüeh 江西修水山背地區考古調查與試掘
Trial Diggings and Archaeological Investigations of Hsiu-Shui and Shan-Pei in Kiangsi Province.
,0:(1962),7, pp. 353-67.

Anon. *(622).*
Kiangsi Nan-Chhang Chin-Mu 江西南昌晉墓
A Chin Dynasty Tomb Excavated at Nan-Chhang in Kiangsi Province.
*^(i974).6, PP- 373-8-

Anon. *(623).*
Kiangsu I-Liu Ti-Chhü Hu-Shu Wen-Hua I-Chih Tiao-Chha 江蘇儀六地區湖熟文化遺址調查
Investigation of Hu-shu Cultural Sites in the Region of Liu-Ho and I-Cheng in Kiangsu.
KK (1962), 3, pp. 125-8, 133.

Anon. *(624).*
Kiangsu Hsü-Chou Han-Mu Hua-Hsiang-Shih 江蘇徐州漢墓畫象石
Han Stone Reliefs from Hsü-Chou in Kiangsu. Peking, 1959.

Anon. (6¾).
Kiangsu Phi-Hsien Liu-Lin Hsin-Shih-Chhi Shih- Tai I-Chih Ti-Erh- Tzhu Fa-Chüeh 江蘇邳縣劉林新石器時代遺址第二次發掘
Excavations (Second Season) of the Neolithic Site at Liu-Lin, Phi-Hsien, Kiangsu.
Ä7i7//>(i965),$_2$,pp.9-48.

Anon. *(626).*
Kiangsu Phi-Hsien Ssu-Hu-Chen Ta- Tun- Tzu I-Chih Than-Chiieh Pao-Kao 江蘇邳縣四戶鎮大墩子遺址探掘報告
Trial Diggings at Ta-Tun-Tzu in Ssu-Hu-Chen, Phi County, Kiangsu Province.
A-A7/i>(i$_9$64),$_a$,pp.9-$_5$6.

Anon. *(627).*
Kiangsu Wu-Chin Ssu- Tun I-Chih ti Shih-Chüeh 江蘇武進寺墩遺址的試掘
Trial Digging of a Neolithic Site at Ssu-Tun, Wu-Chin, Kiangsu.
AX (1981),3, pp. 193-200.

Anon. *(628).*
Chhien-Shan Hsüeh-Chia-Kang Hsin-Shih-Chhi Shih-Tai I-Chih 潛山薛家崗新石器時代遺址
The Neolithic Site at Hsüeh-Chia-Kang, Chhien-Shan County, Anhui.
KKHP (1982), 3, pp. 283-324.

Anon. (629).
Chin-Nan Erh-Li- Thou Wen-Hua I-Chih ti Tiao-Chha yü Shih-Chüeh 晉南二里斗文化遺址的調查與試掘
Reconnaissances and Trial Diggings of the Erh-Li-Thou Sites in South Shansi.
KK (1980), 3, pp. 203-10.

Anon. *{630).*
Ching-Shan Chhü-Chia-Ling 京山屈家嶺
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院研究所 (ed.), Kho-Hsüeh, Peking, 1965.

Anon. (65/).
Tsai-Sang Tang- Tshan I-Pai- Wen 栽桑養蠶一百問
One Hundred Questions and Answers to the Arts of Mulberry Planting and Silkworm Rearing.
Chekiang-Sheng Tshan-Sang Hsüeh-Hui (ed.), Nung-Yeh, Peking, 1984.

Anon. *(632).*
Chhing-Hai Tüeh-Tu Liu-Wan Yüan-Shih She-Hui Mu- Ti Fan- Ting Chhu ti Chu- Tao Wen- Thi 青海樂都柳灣原始社會墓地反映出的主要問題
The Main Issues Posed by the Finds from the Primitive Society Cemetery at Liu-Wan in Yüeh-Tu County, Chhing-Hai.
.^(1976),6, pp. 365-77.

Anon. *(633).*
Chhing- Tao-Shih Chiao-Chhü Fa-Hsien Hsin-Shih-Chhi Shih- Tai ho Tin Chou I-Chih ^ H rfj SB
m.mmm-G&mtt%immî&ik
Neolithic, Shang and Chou Sites in the Suburbs of Chhing-Tao.
,0:(1965),9, pp. 480-1.

Anon. *(634).*
Chhing- Tao-Shih Lao-Shan Chiao-Chhü Tung Ku-Chen- Tshun Tung-Chou I-Chih W S» ïfî *$ U4
3 E S * i « î i i t f c
The Eastern Chou Site of East Ku-Chen Village in the Suburbs of Lao-Shan, Chhing-Tao City.
^^959).3. PP- H3-6-

Anon. (655).
Cku-Tzu Chi-Chheng 諸子集成
A Complete Collection of the Various Schools of Thought and Their Exponents.
Peking, 1959.

Anon. *(636).*
Chhu- Tu Chi-Nan-Chheng ti Khan-Chhayü Fa-Chüeh (hsia) 楚都紀南城的勘查與發掘(下).
The Exploration and Excavation of the Ancient

Anon. *{636) (cont.)*
Chhu Capital, Chi-Nan City (Part Two).
KKHP (1982), 4, pp. 477-507.

Anon. (637).
Chhu Wen- Wu Chan-Lan Thu-Lu 楚文物展覽圖錄
Illustrated Catalogue of an Exhibition of the Cultural Relics of Chhu.
Peking Li-Shih Po-Wu-Kuan 北京歷史博物館
(ed.), Peking, 1954.

Anon. *(638).*
Chügoku Bukkyö no Tabi 中国仏教の旅
Buddhist Travel-guide through China.
Chügoku bukkyö kyökai 中国仏教協会
(ed.), Bi-no-bi, Kyoto, 1980.

Anon. *(63g).*
Chhun-Chhiu Tsao-Chhi Huang-Chün Meng Fu Fu Mu Fa-Chüeh Pao-Kao 春秋早期黃君孟夫婦墓發掘報告
Excavation of the Tombs of Prince Meng and His Wife of the Huang State in the Early Spring and Autumn Period.
KK (1984), 4, pp. 302-32.

Anon. *(640).*
Chung-Hua Jen-Min Kung-Ho-Kuo Fen-Sheng Ti-Thu-Chi 中華人民共和國分省地圖集
Atlas of the Provinces of the People's Republic of China.
Ti-Thu Chhu-Pan-She 地圖出版社
(ed.), Peking, 1974.

Anon. *{641).*
Chung-Kuo Ku- Tai Kho-Chi Chheng-Chiu 中國古代科技成就
China's Historical Achievements in Science and Technology.
Tzu-Jan Kho-Hsüeh-Shih Yen-Chiu-So 自然科學史研究所
(ed.), Kho-Hsüeh, Peking, 1978.

Anon. *(642).*
Chung-Kuo Ku- Tai-Skih Chhang-Shih 中國古代史常識
General Knowledge about the History of Chinese Ancient Times.
Chung-Kuo Chhing-Nien Chhu-Pan-She 中國青年出版社
(ed.), Peking, 1980.

Anon. *(643).*
Chung-Kuo Shao-Shu Min- Tsu 中國少數民族
Chinese Minorities.
Chung-Kuo Shao-Shu Min-Tsu Pien Hsieh-Tsu 中國少數民族編寫組
(ed.), Peking, 1981.

Anon. *(644).*
Fang-Chih Shih-Hua 紡織史話
On the History of Textile Technology.
Shanghai-Shih Fang-Chih Kho-Hsüeh Yen-Chiu-Yüan 上海市紡織科學研究院
(ed.), Shanghai Kho-Hsüeh, Shanghai, 1978.

Anon. *(645).*
Feng-Hsi Fa-Chüeh Pao-Kao 澧西發掘報告
Excavation at Feng-Hsi (1955-1957).
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院考古研究所
(ed.), Kho-Hsüeh, Peking, 1962.

Anon. *(646).*
Fu-Chou Fu- Tshun I-Chih ti Fa-Chüeh 福州浮村遺址的發掘
Excavation of an Ancient Site at Fu-Tshun, Fuchou.
KKHP(i$_{95}$8), a, pp. 17-27.

Anon. (647).
Fukien Chhang- Thing Ho- Thien Hsin-Shih-Chhi Shih- Tai I-Chih ti Tiao-Chha 福建長汀河田新石器時代遺址的調查
Neolithic Sites recendy Discovered in Ho-Thien, Chhang-Thing, Fukien.
ÄT///>(i$_{9}$57), 1^.37-42.

Anon. *{648).*
Fukien Feng-Chou Shih- Tzu-Shan Hsin-Shih-Chhi Shih-Tai I-Chih 福建豐州獅子山新石器時代遺址
The Neolithic Site of Shih-Tzu-Shan, Feng-Chou, Fukien.
KK (1961),4, pp. 194-6.

Anon. *(64()).*
Fukien Fu-Chhing Tung-Chang Hsin-Shih-Chhi Shih-Tai I-Chih Fa-Chüeh Pao-Kao 福建福清東張新石器時代遺址發掘報告
Excavations of a Neolithic Site at Tung-Chang, Fu-Chhing County, Fukien.
ÄX (1965).2. pp- 49-61, 79-

Anon. (6jo).
Fukien Wu-Phing Hsin-Shih-Chhi Shih-Tai I-Chih Tiao-Chha Pao-Kao 福建武平新石器時代遺址調查報告
Report on the Neolithic Site of Wu-Phing in Fukien.
KK (1961),4, pp. 179-84.

Anon. (65/).
Hang-Chou Shui- Thien-Pan I-Chih Fa-Chüeh Pao-Kao 杭州水田畈遺址發掘報告
Excavations at the Neolithic Site of Shui-Thien-Pan, Hang-chou.
KKHP (i960), 2, pp. 93-106.

Anon. (652).
Heilungchiang Chao- Yuan Pai-Chin-Pao I-Chih Ti-I-Tzhu Fa-Chüeh 黑龍江肇源白金寶遺址第一次發掘
First Season of Excavation of the Pai-Chin-Pao Site at Chao-Yuan in Heilungchiang.
/^(1980),4, pp. 311-24.

Anon. *(653).*
Heilungchiang JVing-An-Hsien Ting-Ko-Ling I-Chih 黑龍江寧安縣鶯歌嶺遺址
Excavation of the Ying-Ko-Ling Site at Ning-An in Heilungchiang.
KK (1981), 6, pp. 481 -91.

Anon. (654).
Heilungchiang Ning-An Niu-Chhang Hsin-Shih-Chhi Shih- Tai I-Chih Chhing-Li 黑龍江寧安牛場新石器時代遺址清理
Clearing of the Neolithic Site of Niu-Chhang, Ning-An, Heilungchiang.

Anon. *{654) (cont.)*
KK (i960), 4, pp. 20-2.

Anon. (655).
Honan Hsi-Chhuan Hsia- Wang-Kang I-Chih ti Shih-Chiieh 河南淅川下王崗遺址的試掘
Trial Diggings at the Site of Hsia-Wang-Kang, Hsi-Chhuan, Honan.
WW (1972), 10, pp. 6-19.

Anon. *(656).*
Honan Hsin-Cheng Phei-Li-Kang Hsin-Shih-Chhi Shih-Tai I-Chih 河南新鄭裴李崗新石器時代遺址
The Neolithic Site at Phei-Li-Kang in Hsin-Cheng County, Honan.
AX (1978), a, pp. 73-9.

Anon. (657).
Honan Hsin- Yang San-Li- Tien I-Chih Fa-Chüeh Pao-Kao 河南信陽三里店遺址發掘報告
The Excavation of the Neolithic Sites at San-Li-Tien, Hsin-Yang, Honan.
XAY//> (1959),1, pp. i n .

Anon. (6j5).
Honan Hsing- Tang Ho- Wang Hsin-Shih-Chhi Shih-Tai I-Chih 河南滎陽河王新石器時代遺址
The Neolithic Site of Ho-Wang in Hsing-Yang, Honan.
AX (1961),2, pp. 94-8.

Anon. *(65g).*
Honan Lin-Ju Mei-Shan I-Chih Fa-Chüeh Pao-Kao 河南臨汝煤山遺址發掘報告
Excavation of the Mei-Shan Sites in Lin-Ju, Honan Province.
KKHP (1982), 4, pp. 427-76.

Anon. *(660).*
Honan Meng-Hsien Chien-Hsi I-Chih Fa-Chüeh 河南孟縣澗溪遺址發掘
Excavation of the Site at Chien-River, Meng County, Honan.
AX(i96i), ,, pp. 33-9.

Anon. *(661).*
Honan Mi-Tang Pan-Chhiao Shih-Chhi Shih-Tai /-Chih ti Tiao-Chha ho Shih-Chiieh 河南泌陽板橋石器時代遺址的調查和試掘
Investigations and Trial Diggings Conducted at the Neolithic Site at Pan-Chhiao in Mi-Yang County, Honan.
AX (1965), 9, pp. 433-9-

Anon. *(662).*
Honan Mien-Chhih Hsi-Ho-An- Tshun Hsin-Shih-Chhi Shih- Tai I-Chih Fa-Chiieh Chien-Pao 河南澠池西河庵村新石器時代遺址發掘簡報
Excavation Report from the Stone Age Site of Hsin-Ho-An-Tshun in Mien-Chhih County, Honan Province.
AX (1965), 10, pp. 498-9.

Anon. (663).
Honan Shan-Hsien Chhi-Li-Phu Shang- Tai I-Chih ti Fa-Chüeh 河南陝縣七里鋪商代遺址的發掘
Excavation of a Shang Site at Chhi-Li-Phu, Shan County, Honan.
XX///» (:960), i, pp. 25-47.

Anon. *{664).*
Honan Shan-Hsien Chhi-Li-Phu Ti-I-Erh Chhü Fa-Chüeh Kai- Tao 河南陝縣七里鋪第一、二區發掘概要
Abstract on the First and Second Place of Excavation at the Site of Chhi-Li-Phu, Shan County, Honan.
AX (1959), 4, pp. 176-80.

Anon. (6¾).
Honan Thang-Ho Chai- Tzhu-Kang Hsin-Shih-Chhi Shih- Tai I-Chih 河南唐河寨茨崗新石器時代遺址
The Neolithic Site at Chai-Tzhu-Kang, Thang-Ho, Honan.
XX (1963), 12, pp. 641-5.

Anon. *(666).*
Honan Thang-Ho Mao- Tshao-Ssu Hsin-Shih-Chhi Shih- Tai I-Chih 河南唐河茅草寺新石器時代遺址
The Neolithic Site at Mao-Tshao-Ssu, Thang-Ho County, Honan.
XX (1965), 1, pp. 1-5.

Anon. (667).
Honan Ten-Shih Thang-Chhüan-Kou Hsin-Shih-Chhi Shih- Tai I-Chih ti Shih-Chüeh 河南偃師湯泉溝新石器時代遺址的試掘
Trial Diggings at the Neolithic Site of Thang-Chhüan-Kou, Yen-Shih, Honan.
KK (1962), 11, pp. 562-5, 600.

Anon. *(668).*
Hopei Chang-Chia-Khou Ti-Chhü Hsin-Shih-Chhi Shih- Tai I-Chih Tiao-Chha 河北張家口地區新石器時代遺址調查
Investigation of a Neolithic Site near Chang-Chia-Khou, Hopei.
AX (1959), 7, pp. 332-7.

Anon. (6¾).
Hopei Thang-Shan-Shih Ta-Chheng-Shan I-Chih Fa-Chüeh Pao-Kao 河北唐山市大城山遺址發掘報告
The Neolithic Sites at Ta-Chheng-Shan, Thang-Shan City, Hopei Province.
XX//P(i$_9$59),3, pp. 17-35.

Anon. *(6yo).*
Hsi-An Fu-Chin Ku Wen-Hua I- Tshun ti Lei-Hsing ho Fen-Pu 西安附近古文化遺存的類型和分佈
Type and Distribution of the Cultural Relics Preserved in the Neighbourhood of Sian.
KKTH (1956), 2, pp. 32-8.

Anon. (67/).
Hsi-An Pan-Pho 西安半坡
The Neolithic Village at Pan-Pho, Sian.
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院考古研究所 (ed.), Kho-Hsüeh, Peking, 1963.

Anon. (672).
Hsi- Tsang Mo- Tho-Hsienju Fa-Hsien I-Phi Hsin-Shih-Chhi Shih-Tai I-Wu 西藏墨脫縣又

Anon. *(672) (cont.)*
發現一批新石器時代遺物
Neolithic Remains Excavated from Sites in Mo-Tho County, Tibet.
AX (1978), 2, pp. 136-7.

Anon. *(673).*
Hsiao Tzhu-Tien: Thao-Tzhu 小辭典:陶瓷
Small Cyclopaedia: Ceramics.
WW (1979),12, pp. 88-9.

Anon. *(674).*
Hsin Fa-Hsien ti Chhang-Sha Chan-Kuo Chhu-Mu Po-Hua 新發現的長沙戰國楚墓帛畫
A New Silk Painting from a Warring States Chhu Tomb at Chhang-Sha.
W^ (1973),7. PP- 3-4-

Anon. (675).
Sinkiang Chhu- Thu Wen- Wu 新疆出土文物
Cultural Relics Unearthed in Sinkiang.
Sinkiang Wei-Wu-Erh Tzu-Chih-Chhü Po-Wu-Kuan 新疆維吾爾自治區博物館 (ed.), Wen-Wu, Peking, 1975.

Anon. *(6y6).*
Sinkiang Min-Feng-Hsien Pei Ta-Sha-Mo Chung Ku I-Chih Mu- Tsang-Chhü Tung-Han Ho- Tsang-Mu 新疆民豐縣北大沙漠中古遺址墓葬區東漢合葬墓
The Eastern Han Necropolis in the Taklamakan Desert North of Min-Feng County, Sinkiang.
WW (i960), 6, pp. 9-12.

Anon. *(6yy).*
Sinkiang Min-Feng Ta-Sha-Mo Chung ti Ku- Tai I-Chih 新疆民豐大沙漠中的古代遺址
Ancient Sites in the Taklamakan Desert, Min-Feng County, Sinkiang.
KK (1961), 3, pp. 119-22, 126.

Anon. (675).
Hsin-I Hua- Thing- Tshun Hsin-Shih-Chhi Shih- Tai I-Chih Kai-Khuang 新沂花廳村新石器時代遺址概況
Abstracts of the Neolithic Site of Hua-Thing-Tshun, Hsin-I, Kiangsu.
WW (1956), 7, pp. 23-6.

Anon. *(6yg).*
Hsii-Chou Kao-Huang-Miao I-Chih Chhing-Li Pao-Kao 徐州高皇廟遺址清理報告
Excavations at Kao-Huang-Miao, Hsii-Chou, Kiangsu.
KKHP (*i*$_{958}$), 4, pp. 7-.8.

Anon. *(680).*
Hunan An-Hsiang-Hsien Thang-Chia-Kang Hsin-Shih-Chhi Shih- Tai I-Chih 湖南安鄉縣湯家崗新石器時代遺址
A Neolithic Site Excavated at Thang-Chia-Kang, An-Hsiang County, Hunan.
KK (1982), 4, pp. 341-54.

Anon. *(681).*
Hunan Chhang- Te Te-Shan Chan-Kuo Mu- Tsang 湖南常德德山戰國墓葬
Warring States Tombs of Te-Shan, Chhang-Te, Hunan.
KK (1959). «a. PP- 658-62.

Anon. *(682).*
Hupei Chhi-Chhun I-Chia-Shan Hsin-Shih-Chhi Shih-Tai 1-Chih Tiao-Chha Chien-Pao 湖北圻春易家山新石器時代遺址調查簡報
Report on the Neolithic Sites of I-Chia-Shan, Chhi-Chhun, Hupei.
KKTH (*IQ*$_{5}$*6), 3,* pp. 21-4.

Anon. *{683).*
Hupei Chiang-Ling Ma-Shan Chuan-Chhang 1-Hao Mu Chhu- Thu Ta-Phi Chan-Kuo Shih-Chhi Ssu-Chih-Phin 湖北江陵馬山磚廠一號墓出土大批戰國時期絲織品
Silk Fabrics of the Warring States Period Unearthed in no. 1 Tomb at Ma-Shan Brickfield in Chiang-Ling, Hupei.
WW (1982), 10, pp. 1-8.

Anon. (6¾).
Hupei Chiang-Ling San- Tso Chhu-Mu Chhu- Thu Ta-Phi Chung- Yao Wen- Wu 湖北江陵三座楚墓出土大批重要文物
Many Important Cultural Relics Excavated from Three Chhu Tombs in Chiang-Ling, Hupei Province.
WW (1966), 5, pp. 33-50.

Anon. (6¾).
Hupei Chih-Chiang-Hsien Kuan-Miao-Shan Hsin-Shih-Chhi Shih- Tai I-Chih Fa-Chiieh Chien-Pao 湖北枝江縣關廟山新石器時代遺址發掘簡報
Excavation of a Neolithic Site at Kuan-Miao-Shan, Chih-Chiang, Hupei.
KK (1981),4, pp. 289-97.

Anon. (686").
Hupei Ching-Shan Thien-Men Khao-Ku Fa-Chiieh Pao-Kao 湖北京山天門考古發掘報告
Archaeological Report on the Excavation in Thien-Men, Ching-Shan County, Hupei.
A"A"77/(i956),3, pp. 11-21.

Anon. (687).
[977 Nien Honan Yung-Chheng Wang-Yu-Fang I-Chih Fa-Chiieh Kai-Khuang 1977年河南永城王油坊遺址發掘概況
Excavation at Wang-Yu-Fang in Yung-Chheng, Honan.
KK (1978), 1, pp. 35-40, 64.

Anon. *(688).*
'979 Nien Phei-Li-Kang I-Chih Fa-Chiieh Chien-Pao 1979年裴李崗遺址發掘簡報
Excavation of the Phei-Li-Kang Neolithic Site in 1979 (Honan).
£"£"(1982), 4, pp. 337-340.

Anon. *[68g).*
[975 Nien Yu-Hsi Khao-Ku Tiao-Chha 1975年豫西考古調查
Archaeological Reconnaissances in West Honan, '975-
-^(1978), i,PP- 23-34.

Anon. (650).
'959 Nien Honan Yen-Shih Erh-Li- Thou Shih-Chüeh Chien-Pao 1959年河南偃師二里頭試掘簡報
Trial Diggings at the Erh-Li-Thou Site at Yen-

Anon. *(690) (cont.)*
Shih, Honan in 1959.
ATAT (1961), a, pp. 81-5.

Anon. (69/).
ig=)8 chih ig6i Men Hupei Yiin-Hsien ho Chiin-Hsien Fa-Chiieh Chien-Pao 1958至1961年湖北鄖縣和均縣發掘簡報
Report on the Excavations of the Hupei Sites in Yün County and Chün County from 1958 to 1961.
.0:(1961), 10, pp. 519-30.

Anon. (692).
'958 Nien Chhun Honan An- Tang-Shih Ta-Ssu-Khung- Tshun Tin- Tai Mu- Tsang Fa-Chüeh Chien-Pao 1958年春河南安陽市大司空村殷代墓葬發掘簡報
Short Report on the Excavation of the Shang Tomb of Ta-Ssu-Khung-Tshun, An-Yang, Honan Province in the Spring of 1958.
KKTH (1958), 10, pp. 51-62.

Anon. (69?).
J955 Nien Chhiu An- Tang Hsiao- Thun Tin-Hsü ti Fa-Chüeh 1955年秋安陽小屯殷墟的發掘
Excavation of the Yin Site Hsiao-Thun, An-Yang in the Autumn of 1955.
KKHP (i95S), 3, pp. 63-72.'

Anon. *(694).*
Jih-Chao-Hsien Liang-Chheng-Chen Teng Chhi Ko I-Chih Chhu-Pu Khan-Chha 日照縣兩城鎮等七個遺址初步勘查
Preliminary Investigations on the Site of Liang-Chheng-Chen and seven others in Jih-Chao County, Shantung.
*fW(i955). 12, pp. 20-41.

Anon. *(695).*
Jih-Chao Liang-Chheng-Chen Lung-Shan Wen-Hua I-Chih Tiao-Chha 日照兩城鎮龍山文化遺址調查
Archaeological Survey of the Neolithic Site of the Lung-shan Culture at Liang-Chheng-Chen, Jih-Chao.
KKHP (1958),1, pp. 25-42.

Anon. *(6g6).*
Kansu Wu- Wei-Hsien Ta- Tung Fu-Chin ti Liang Ko Hsin-Shih-Chhi Shih- Tai I-Chih 甘肅武威縣大坮附近的兩個新石器時代遺址
Two Neolithic Sites near Ta-Tung in Wu-Wei County, Kansu.
WW (1955), 11, pp. 63-6.

Anon. (697).
Kansu Wu-Wei Huang-Niang-Niang-Thai I-Chih Fa-Chiieh Pao-Kao 甘肅武威皇娘娘台遺址發掘報告
Excavations of a Neolithic Site at Huang-Niang-Niang-Thai, Wu-Wei County, Kansu.
Ä-A7//>(i96o),a,pp.53-7i.

Anon. *(6()8).*
Kansu Wu- Wei Mo- Tsui- Tzu Han-Mu Fa-Chüeh 甘肅武威磨咀子漢墓發掘
Excavations of a Han Tomb of Mo-Tsui-Tzu in Wu-Wei County, Kansu Province.
/^(1960),9, pp. 15-30.

Anon. (699).
Kansu Tung-Ching Chang-Chia- Tsuiyü Chi-Chia-Chhuan I-Chih ti Fa-Chüeh 甘肅永靖張家咀與姬家川遺址的發掘
Excavations of the Chang-Chia-Tsui and Chi-Chia-Chhuan Sites at Yung-Ching County in Kansu Province.
KKHP (1980), a, pp. 187-220.

Anon. *(700).*
Kansu Tung-Ching Ma-Chia- Wan Hsin-Shih-Chhi Shih- Tai I-Chih ti Fa-Chüeh 甘肅永靖馬家灣新石器時代遺址的發掘
Excavation of the Neolithic Site at Ma-Chia-Wan in Yung-Ching County, Kansu Province.
A"JSr(i975),a, pp. 90-6, 101.

Anon. (707).
Kanton Li £oku Senshoku Shishu 広東黎族染織刺繡
Textile Crafts of the Li Minority in Kuangtung.
Chügoku Kôshû Bijutsu Gakuin 中国広州美術学院
(ed.), Bi-no-bi, Kyoto, 1982.
(Chügoku Kögei Bijutsu Sösho 中国工芸美術叢書. Chügoku Shösü Minzoku Senshoku Shishü Hen.4.). 中国少数民族染織刺繡篇.4.

Anon. *(yo2).*
Kuang-Ho Ti-Pa-Phing "Pan-Shan Lei-Hsing" Mu-Ti 廣河地巴坪"半山類型"墓地
Excavation of a Neolithic Cemetery of the "Pan-Shan" Type at Ti-Pa-Phing in Kuang-Ho County, Kansu Province.
KKHP (itfS),,pp.* 193-210.

Anon. *(703).*
Kuangsi Kuei-Hsien Lo-Po- Wan I-Hao Mu Fa-Chüeh Chien-Pao 廣西貴縣羅泊灣一號墓發掘簡報
Excavation of the Tomb no. 1 at Lo-Po-Wan in Kuei-Hsien, Kuangsi.
11^(1978),9, pp. 25-42.

Anon. *(704).*
Kuang-She I-Chih Tiao-Chha Shih-Chüeh Chien-Pao 光社遺址調查試掘簡報
Trial Digging at the Site of Kuang Commune, Thai-Yüan City.
WW (1962), 4-5, pp. 28-32.

Anon. *(705).*
Kuangtung Chung-Pu Ti- Ti-Chhü Hsin-Shih-Chhi Shih- Tai I- Tshun 廣東中部低地區新石器時代遺存
Neolithic Remains in the Lowlands of Central Kuangtung.
KKHP (i960), 3, pp. 107-19.

Anon. *(706).*
Kueichou Chhing-Chen Phing-Pa Han chih Sung Mu Fa-Chüeh Chien-Pao 貴州清鎮平壩漢至宋墓發掘簡報
Report from the Excavation of the Han to Sung Tombs at Phing-Pa in Chhing-Chen County, Kueichou.

Anon. (706) *(cont.)*
KK (1961), 4, pp. 207-11.
Anon. *(yoy).*
Kueichou Wei-Ning Ckung-Ho Fa-Hsien Hsin-Shih-Chhi Shih-Tai I-Wu 貴州威宁中河發現新石器時代遺物
Remains Excavated at the Neolithic Site of Chung-Ho, Wei-Ning, Kueichou.
WW (1973), i, pp. 61-2.
Anon. *{708).*
Li-Hsien Meng-Hsi Hsin-Shih-Chhi Shih- Tai I-Chih Shih-Chüeh Chien~Pao 澧縣夢溪新石器時代遺址試掘簡報
Trial Diggings at the Neolithic Site of Meng-Hsi, Li County, Hunan.
WW (1972), a, pp. 31-8.
Anon. *(yog).*
Liang-Chu Ku- Til Than- Thao 良渚古玉探討
Research on Ancient Jade from the Liang-chu Culture.
KKTH (1957), 3, pp. 77-80.
Anon. *(yio).*
Lin- Tzu Lang-Chia-Chuang I-Hao Tung-Chou Hsiin Jen Mu 臨淄郎家庄一號東周殉人墓
Excavation of Eastern Chou Tomb no. 1 with Human Sacrifices at Lang-Chia-Chuang in Lin-Tzu, Shantung Province.
KKHP (1977), 1, pp. 73-104.
Anon, *(yii).*
Lu-wei 蘆葦
Phragmites communis Trin.
Chhing-Kung-Yeh Chhu-Pan-She 輕工業出版社
(ed.), Tientsin, 1978.
Anon. *(yis).*
Miao- Ti-Kouyii San-Li-Chhiao 廟底溝與三里橋
Miao-Ti-Kou and San-Li-Chhiao. Archaeological Excavations at the Yellow River Reservoirs Report No. 2.
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院考古研究所
(ed.), Peking, 1959.
Anon. (7/5).
Min-Hou Than-Shih-Shan Hsin-Shih-Chhi Shih- Tai I-Chih Than-Chiieh Pao-Kao 閩侯曇石山新石器時代遺址探掘報告
Trial Diggings at the Neolithic Site of Than-Shih-Shan, Min-Hou County, Fukien.
KKHP (i_{955}), *10*, pp. 53-68.
Anon. *(714).*
Min-Hou Than-Shih-Shan I-Chih Ti-Liu- Tzhu Fa-Chiieh Pao-Kao 閩侯曇石山遺址第六次發掘報告
Excavations (Sixth Season) at Than-Shih-Shan in Min-Hou County, Fukien.
KKHP (1976), 1, pp. 83-118.
Anon. (7/5).
Min-Nan Hsin-Shih-Chhi Shih- Tai ti Tiao-Chha 閩南新石器時代的調查
Investigation on Neolithic Sites of South Fukien.
AX (1961),5, pp. 237-44.
Anon. (7/6).
Min-Pei Chien-Ou ho Chien-Tang Hsin-Shih-Chhi Shih- Tai I-Chih Tiao-Chha 閩北建甌和建陽新石器時代遺址調查
Investigation in the Neolithic Sites of Chien-Ou and Chien-Yang in North Fukien.
KK (1961), 4, pp. 185-92, 202.
Anon. (7/7).
Ming Chhing Tzu-Pen Chu-I Meng- Ta Ten-Chin Lun-Wen-Chi 明清資本主義萌芽研究論文集
Monograph on Chinese Nascent Capitalism in the Ming and Chhing Dynasties.
Nanking Ta-Hsüeh Li-Shih-Hsi 南京大學歷史系
Ming Chhing Shih Yen-Chiu-Shih Pien 明清史研究室編
(eds.), Shanghai Jen-Min, Shanghai, 1981.
Anon. *(yi8).*
Nanking Hsi-Shan-Chhiao Thai-Kang-Ssu I-Chih ti Fa-Chüeh 南京西善橋太崗寺遺址的發掘
Excavation of the Thai-Kang-Ssu Site at Hsi-Shan-Chhiao, Nanking.
KK (1962), 3, pp. 117-24.
Anon. (7/9).
Nanking-Shih Pei- Tin- Tang- Ting Ti-I-Erh- Tzhu ti Fa-Chiieh 南京市北陰陽營第一二次的發掘
The First and Second Excavations at Pei-Yin-Yang-Ying, Nanking.
KKHP(i_{95}H),i,pp. 7-23.
Anon. *(720).*
Nei-Meng-Ku Chao- Wu- Ta-Meng Shih- Tang-Shih-Hu-Shan Hsin-Shih-Chhi Shih- Tai Mu- Tsang 內蒙古昭烏達盟石羊石虎山新石器時代墓葬
Stone Age Tombs at Shih-Yang-Shih-Hu-Shan, Chao-Wu-Ta-Meng, Inner Mongolia.
KK (1963), 10, pp. 523-4, 546.
Anon. *[721).*
Nei-Meng-Ku Chung-Nan-Pu Huang-Ho Ten-An Hsin-Shih-Chhi Shih- Tai I-Chih Tiao-Chha 內蒙古中南部黃河沿岸新石器時代遺址調查
Investigation of the Neolithic Sites along the Huang-Ho in the Southern Part of Inner Mongolia.
Ä"Ä"(i9^{6}5). 10. PP-487-97-
Anon. *(722).*
Nishijin—Bi to Dento 西陣美と伝統
Nishijin Fabrics—Beauty and Tradition.
Nishijin Hakubutsukan 西陣博物館
(ed.), Kyoto, 1969.
Anon. *(723).*
Pao-Chi Hsin-Shih-Chhi Shi- Tai I-Chih Ti-Erh-San-Tzhu Fa-Chüeh ti Chu-Tao Shou-Huo 寶鷄新石器時代遺址第二三次發掘的主要收獲
Important Results of the Second and Third Excavation at the New Stone Age Site of Pao-Chi, Shensi.

Anon. *{723) (cont.)*
/TA" (i960), a, pp. 4-7.

Anon. *[724).*
Phei-Li-Kang I-Chih 1978 Nien Fa-Chüeh Chien-Pao 裴李崗遺址1978年發掘簡報
Excavations at the Phei-Li-Kang Site, 1978.
KK (1979), 3. PP- 197-2°5-

Anon. *(725).*
Shanghai Ma-Chhiao I-Chih Ti-I-Erh- Tzhu Fa-Chüeh 上海馬橋遺址第一二次發掘
Excavations (First and Second Seasons) at the Ma-Chhiao Site in Shanghai.
KKHP (1978), 1, pp. 109-37.

Anon. *(726).*
Shanghai-Shih Chhing-Phu-Hsien Sung- Tse I-Chih ti Shih-Chüeh 上海市青浦縣崧澤遺址的試掘
Trial Diggings at the Site of Sung-Tse, Chhing-Phu County, City of Shanghai.
KKHP (1962),3, pp. 1-29.

Anon. *(727).*
Shanghai-Shih Sung-Chiang-Hsien Kuang-Fu-Lin Hsin-Shih-Chhi Shih- Tai I-Chih Shih- Than 上海市松江縣廣富林新石器時代遺址試探
Investigation of the Neolithic Site of Kuang-Fu-Lin, Sung-Chiang County, City of Shanghai.
ÄX (1962),9. pp. 465-9.

Anon. *(728).*
Shansi Jui-Chheng Tung-Chuang- Tshun ho Hsi-Wang-Tshun I-Chih ti Fa-Chüeh 山西芮城東庄村和西王村遺址的發掘
Excavation of the Neolithic Site at Tung-Chuang and Hsi-Wang Villages in Jui-Chheng County, Shansi.
KKHP (1973), 1, pp. 1-62.

Anon. *(72g).*
Shantung An-Chhiu Thung- Tu Hu- Tu Hsin-Shih-Chhi Shih- Tai I-Chih Tiao-Chha 山東安丘峒峪胡峪新石器時代遺址調查
Reconnaissance of Neolithic Sites at Thung-Yü and Hu-Yü, An-Chhiu, Shantung.
^(1963), 10, PP-529-35.

Anon. *(730).*
Shantung Chiao-Tung Ti-Chhü Hsin-Shih-Chhi Shih-Tai I-Chih ti Tiao-Chha 山東膠東地區新石器時代遺址的調查
Excavation of the Neolithic Site in the Chiao-Tung Peninsula, Shantung.
-^(1963).7. PP- 369-76.

Anon. *(731).*
Shantung Chhü-Fu Hsi-Hsia-Hou I-Chih Ti-I- Tzhu Fa-Chüeh Pao-Kao 山東曲阜西夏侯遺址第一次發掘報告
Excavations (First Season) at West Hsia-Hou in Chhü-Fu County, Shantung.
KKHP (1964), 2, pp. 47-106.

Anon. *(732).*
Shantung Pheng-Lai Tzu-Ching-Shan I-Chih Shih-Chüeh Chien-Pao 山東蓬萊紫荊山遺址試掘簡報
Trial Diggings at the Neolithic Site of Tzu-Ching-Shan, Pheng-Lai County, Shantung.
-^(1973). '.PP- 11-15-

Anon. *(733).*
Shantung Phing- Tu Tung- Tiieh Shih- Tshun Hsin-Shih-Chhi Shih- Tai I-Chihyü Chan-Kuo Mu 山東平度東岳石村新石器時代遺址與戰國墓
Neolithic Sites and Warring States Tombs at Tung-Yüeh and Shih-Tshun in Phing-Tu, Shantung.
ÄX(ig62), 10, pp. 509-18.

Anon. *(734).*
Shantung Ssu-Shui Ten-Chou Khao-Ku Tiao-Chha Chien-Pao 山東泗水兗州考古調查簡報
Archaeological Report on the Ssu-Shui and Yen-Chou Sites, Shantung.
^(1965), 1, pp. 6-12, 39.

Anon. (7.¾).
Shantung Ssu-Shui Tin-Chia-Chheng Ti-I- Tzhu Shih-Chüeh 山東泗水尹家城第一次試掘
Trial Diggings at the Neolithic Site of Yin-Chia-Chheng near Ssu-Shui, Shantung.
KK (1980), 1, pp. 11-17, 31.

Anon. *(736).*
Shantung Teh- Tien Hsin-Shih-Chhi Shih- Tai Mu-Tsang I-Chih Shih-Chüeh Chien-Pao 山東野店新石器時代墓葬遺址試掘簡報
Trial Diggings at the Neolithic Site of Yeh-Tien in Shantung.
WW(igj2),a, pp. 25-30.

Anon. *(737).*
Shen- Tang Hsin-Min-Hsien Kao- Thai-Shan I-Chih 沈陽新民縣高台山遺址
Neolithic Site at Kao-Thai-Shan, Hsin-Min County, Shen-Yang.
KK (1982), 2, pp. 121-9.

Anon. *(738).*
Shina Keizai ^ensho 支那経済全書
Encyclopaedia of the Chinese Economy.
Töa Döbunkai 東亜同文会
(comp.), Tokyo, Osaka, 1907-8, 12 vols.

Anon. *(739).*
Shina Sanshigyô Kenkyû 支那蚕絲業研究
Research on the Chinese Silk Industry.
Töa Kenkyüjo 東亜研究所
(ed.), Osaka, 1943.

Anon. *(740).*
Shina Sanshigyô Taikan 支那蚕絲業大観
A General Survey of the Silk Industry in China.
Sanshigyô Dögyökumiai Chüökai 蚕絲業同業組合中央会
(comp.), Tokyo, 1929.

Anon. *(741).*
Shina Shöbetsu £enshi 支那省別全志
Encyclopaedia of the Chinese Provinces.
Töa Döbunkai 東亜同文会
(ed.), Tokyo, 1917-20.

Anon. *(742).*
Shu-Chin Shih-Hua 蜀錦史話
On the History of Shu Brocades.
Szechwan Jen-Min, Chheng-Tu, 1979.

Anon. *{743).*
Ssu-Chhou chih Lu. Han Thang Chih- Wu 絲綢之路. 漢唐織物
Silkroad. Han to Thang Fabrics.
Sinkiang Wei-Wu-Erh Tzu-Chih-Chhü Po-Wu-Kuan 新疆維吾爾自治區博物館 (ed.), Wen-Wu, Peking, 1973.

Anon. *(744).*
Szechwan Chhuan-Kuan- Tsang Fa-Chiieh Pao-Kao 四川船棺葬發掘報告
Excavation Report on the Boat-coffin Tomb in Szechwan.
Chung-Kuo Kho-Hsüeh-Yüan Khao-Ku Yen-Chiu-So 中國科學院考古研究所 (ed.), Peking, i960.

Anon. *(745).*
Szechwan Hsi-Chhang Li-Chou Hsin-Shih-Chhi Shih-Tai I-Chih 四川西昌禮州新石器時代遺址
A Neolithic Site at Hsi-Chhang County in Szechwan Province.
KKHP (1980), 4, pp. 443-456.

Anon. *(746).*
Szechwan Hsin-Fan-Hsien Shui-Kuan- Yin I-Chih Skih-Chiiek Chien-Pao 四川新凡縣水觀音遺址試掘簡報
Trial Diggings at the Site of Shui-Kuan-Yin in Hsin-Fan County, Szechwan.
KK (1959), 8, pp. 404-10.

Anon. *(747).*
Szechwan Pa-Hsien Tung-Sun-Pa Chan-Kuo ho Han-Mu Chhing-Li Chien-Pao 四川巴縣冬笋壩戰國和漢墓清理簡報
Report on the Clearing of Warring States and Han Tombs at Tung-Sun-Pa, Pa County, Szechwan.
ÄX77/(1958),1, pp. 11-32.

Anon. *(748).*
Szechwan Wu-Shan Ta-Hsi Hsin-Shih-Chhi Shih-Tai I-Chih Fa-Chüeh Chi-Lüeh 四川巫山大溪新石器時代遺址發掘記略
Notes on the Digging at the Neolithic Site of Ta-Hsi, Wu-Shan, Szechwan.
WW (1961), 11, pp. 15-21, 60.

Anon. *{74g).*
Ssu-Hung-Hsien Tshao-Chuang Fa-Hsien I-Phi Han-Hua Hsiang-Shih 泗洪縣曹庄發現一批漢畫象石
A Stone Relief from Han Times Excavated in Tshao-Chuang in Ssu-Hung County, Kiangsu Province.
WW (1975), 3, P- 76-

Anon. *(750).*
Ta- Wen-Khou Hsin-Shih-Chhi Shih- Tai Mu- Tsang Fa-Chüeh Pao-Kao 大汶口新石器時代墓葬發掘報告
Report on the Excavation of the Neolithic Tombs of Ta-Wen-Khou.
Peking, 1974.

Anon. (75/).
Tsinan Fa-Hsien ti Sung-Mu Pi-Hua 濟南發現的宋墓壁畫
A Mural Painting Discovered in a Sung Tomb at Tsinan.
WW (i960), 2, pp. 78-9.

Anon. (752).
Thhu-Lu-Fan-Hsien A-Ssu- Tha-Na Ha-La-Ho-Cho Ku-Mu Chhün Fa-Chüeh Chien-Pao 吐魯番縣阿斯塔那哈拉和卓古墓羣發掘簡報
Excavation of Ancient Tombs at Astana and Karakhoja in Turfan 1963-1965.
WW (1972), 1, pp. 8-29; (1973), 10, pp. 7-27.

Anon. *{753).*
Tung- Wu-Hsüeh Ta- Tzhu- Tien 動物學大辭典
Dictionary of Zoology.
Commercial Press, Shanghai, 1932.

Anon. *{754).*
Tzu-Shu Po-Chia 子書百家
Hundred Schools of Philosophers.
Hupei, 1912.

Anon. *{755).*
Wei-Nan Pei-Liu Hsin-Shih-Chhi Shih- Tai Tsao-Chhi I-Chih Tiao-Chha yü Shih-Chüeh Chien-Pao 渭南北劉新石器時代早期遺址調查與試掘簡報
Reconnaissances and Trial Diggings at the Pei-Liu Neolithic Site at Wei-Nan.
KKjiWW (1982),4, pp. 1-9.

Anon. (756").
Wu-Chhan-Chieh-Chi Wen-Hua Ta-Ko-Ming Chung ti Khao-Ku Hsin-Fa-Hsien 無產階級文化大革命中的考古新發現
New Archaeological Finds during the Proletarian Cultural Revolution.
AX (1972), 1, pp. 29-42.

Anon. *(757).*
Wu-Hsing Chhien-Shan- Tang I-Chi Ti-I-Erh- Tzhu Fa-Chüeh Pao-Kao 吳興錢山漾遺蹟第一二次發掘報告
Report on the First (1956) and Second (1958) Excavation of the Chhien-Shan-Yang Remains at Wu-Hsing, Chekiang Province.
KKHP (i960), 2, pp. 73-92.

Anon. (751?).
Wu-Shan Ta-Hsi I-Chih Ti-San- Tzhu Fa-Chüeh 巫山大溪遺址第三次發掘
The Third Season of Excavation at the Ta-Hsi Site in Wu-Shan County.
KKHP (1981), 4, pp. 461-90.

Anon. (7.59).
Yen-Hsia-Tu Ti23 Hao I-Chih Chhu-Thu I-Phi Thung-Ko 燕下都第23號遺址出土一批銅戈
Bronze Dagger-Axes Unearthed in the Site no. 23 at Yen-Hsia-Tu, Hopei.
WW (1982), 8, pp. 42-9.

Anon. (76b).
Ting-Han Fang-Chih-Jan Tzhu-Hui 英漢紡織染詞滙
English-Chinese Textile Dictionary.
Shanghai-Shih Fang-Chih Kung-Yeh-Chü 上海市紡織工業局

Anon. (76b) *(cont.)*
Shanghai-Shih Fang-Chih Kung-Chheng Hsiieh-Hui 上海市紡織工程學會
(eds.), Shanghai, Hong Kong, 1974.

Anon. *(761).*
Tung-Chi Tang- Thun I-Chih Shih-Chiieh Chien-Pao 永吉楊屯遺址試掘簡報
Trial Diggings at Neolithic Sites at Yang-Thun in Yung-Chi County, Kirin.
WW (1973), 8, pp. 63-72.

Anon. *(762).*
Yunnan Chiang-Chhuan Li-Chia-Shan Ku-Mu Chhiin Fa-Chüeh Pao-Kao 雲南江川李家山古墓羣發掘報告
Report on the Excavation of the Ancient Tombs of Li-Chia-Shan in Chiang-Chhuan, Yunnan.
KKHP (1975), a, pp. 97-155-

Anon. (7¾).
Yunnan Chin-Ning Shih-Chai-Shan Ku I-Chih chi Mu- Tsang 雲南晉寧石寨山古遺址及墓葬
Ancient Sites and Tombs from Shih-Chai-Shan, Chin-Ning, Yunnan.
KKHP (1956), 1, pp. 43-63.

Anon. *(764).*
Yûrin Taikan 有鄰大觀
Yürin-Kan 有鄰館
(ed.), Kyoto, 1929-42, vol. 5.

Anon. (765).
Chiang-Su Wu-Hsien Tshao-Hsieh-Shan I-Chih 江蘇吳縣草鞋山遺址
The Site of Tshao-Hsieh-Shan in Wu County, Kiangsu Province.
WWTLTK (1980), 3, pp. 1-24.

Aoki Kunio et al. (eds.) (/) 青木国夫
Edo Kagaku Koten Sösho 江戸科学古典叢書
Collection of Scientific Works of the Edo Period.
Köwa Shuppan, Tokyo, 1978—83.

Asahi Shimbun Sha (ed.) (/) 朝日新聞社
Nihon Kagaku Koten ^ensho 日本科学古典全書
Complete Collection of Old Japanese Scientific Works.
Asahi Shimbun, Tokyo, 1978.

Chai Tse-Chiin (/) 柴澤俊
Chin-tz.hu 晉祠
Shansi Jen-Min, Thai-Yuan, 1980.

Chang Chi (/) 張季
Hsi-Shuang-Pan-Na Thai- Tsu ti Chih- Thao Chi-Shu 西雙版納傣族的製陶技術
Pottery Making among the Thai People of Hsi-Shuang-Pan-Na, Yunnan.
"'" ('959). 39. PP- 488-9-

Chang Chhi-Yün (ed.) *(3)* 張其昀
Chung-Wen Ta-Tzhu-Tien 中文大辭典
The Encyclopaedic Dictionary of the Chinese Language.
Taipei, 1962-8; repr. in 10 vols., 1973.

Chang Chia-Chü *(2)* 張家駒
Liang Sung Ching-Chi Chung-Hsin ti Nan-I 兩宋經濟重心的南移
The Shift of the Economic Centres to the South during the Sung Dynasty.
Hupei Jen-Min, Wu-Han, 1957.

Chang Chia-Chü *(3)* 張家駒
Huang Tao-Pho ho Shanghai Mien-Fang Chih-Yeh 黃道婆和上海棉紡織業
Huang Tao-Pho and the Cotton Industry of Shanghai.
Shanghai Jen-Min, Shanghai, 1961.

Chang Chung-I (/) 張中一
Hunan Chhang-Sha Chhen-Chia- Ta-Shan Chan-Kuo Mu- Tsang Chhing-Li Chien-Pao 湖南長沙陳家大山戰國墓葬清理簡報
Report about the Clearing of the Warring States Tomb at Chhen-Chia-Ta-Shan, Chhang-Sha, Hunan.
*^"(i958),9. PP- 57-61-

Chang Jun-Sheng & Chhen Shih-Chün (/) 張潤生 & 陳士俊
Chung-Kuo Ku- Tai Kho-Chi Ming-Jen Chuan 中國古代科技名人傳
Biographies of Famous Scientists and Technicians of Ancient China.
Chung-Kuo Chhing-Nien, Peking, 1981.

Chang Khai (/) 章楷
Wo-Kuo Tshan-Yeh Fa-Chan Kai-Shu 我國蠶業發展概述
A General Account of Sericulture in Our Country.
Nung-Shih Yen-Chiu Chi-Khan 農史研究集刊
Collected Research on the History of Agriculture.
Peking, i960, pp. 109-38.

Chang Khai *(2)* 章楷
Tshan- Yeh Shih-Hua 蠶業史話
On the History of Sericulture.
Chung-Hua, Peking, 1979. Chung-Kuo Li-Shih Hsiao-Tshung-Shu 中國歷史小叢書.)

Chang Khai *(3)* 章楷
Wo-Kuo Fang-Yang Tso-Tshan ti Chhi-Yüan ho Chuan-Po Khao-Lüeh 我國放養柞蠶的起源和傳播考略
Research Account on the Origin and Dissemination of the Breeding of Tussah-spinners in Ancient China.
TYKH (1982), a, pp. 112 ff.

Chang Khai *(4)* 章楷
Wo-Kuo ti Ku- Tshan-Shu 我國的古蠶書
Old Sericulture Books in China.
CÄWS (1982), a, pp. 89-94.

Chang Khai (5) 章楷
Chung-Kuo Ku- Tai Tsai-Sang Chi-Shu Shih-Liao Yen-Chiu 中國古代栽桑技術史料研究
Research on the History of the Art of Mulberry Planting in Ancient China.
Nung-Yeh, Peking, 1982.

Chang Khai & Yü Hsiu-Ju (eds.) (/) 章楷 & 余秀茹
Chung-Kuo Ku- Tai Yang- Tshan Chi-Shu Shih-Liao Hsiian-Pien 中國古代養蠶技術史料選編

Chang Khai & Yü Hsiu-Ju (eds.) (/) *(cont.)*
Compilation of Material on the History of the Art of Silkworm Rearing in Ancient China.
Nung-Yeh, Peking, 1985.

Chang Te-Chün *(3)* 張德鈞
Liang-Chhim-Nien Lai Wo-Kuo Shih- Tung Hsiang-Chiao-Ching Hsien- Wei-Chih-Pu Khao-Shu 兩千年來我國使用香蕉莖纖維織布考述
An Investigation of Cloth Made from Banana Stem Fibre in Ancient China.
CWHP 植物學報
(i956),5:|>PP- 103-116.

Chang Yen-Huang & Kung Thing-Wan (/) 張彥煌 & 龔廷萬
Szechwan Chao-Hua Pao-Lun-Tiian Wu-Chi Pho-Ta-Mu Chhing-Li Chi 四川昭化寶輪院屋基坡崖墓清理記
Report on the Clearing of a Cliff Tomb in the Foundation of Pao-Lun-Yüan in Chao-Hua, Szechwan Province.
KKTH (1958), 7, pp. 22-30.

Chang Ying-Hsüeh (/) 張映雪
Tenshinshi Geijutsu Hakubutsukar 天津市芸術博物館
Tientsin Museum.
Chügoku no Hakubutsukan 中国の博物館, no. 6.
Kodansha, Tokyo, 1982.

Chao Chheng-Tse (/) 趙承澤
Than Fu-Chou Chin- Than Chhu- Thu ti Nan-Sung Chih-Phin ho Tang-Shih ti Fang-Chih Kung-I 談福州金壇出土的南宋織品和當時的紡織工藝
Discussion on the Silk Fabrics Excavated in Chin-Thhan, Fu-Chou and the Spinning Technology Applied in Southern Sung.
^^ (1977). 7. PP-28-32.

Chao Khang-Min (/) 趙康民
Lin- Thung Titan- Thou Teng-Chia-Chuang I-Chih Khan-Chha-Chi 臨潼原頭鄧家庄遺址勘查記
Report on the Teng-Chia-Chuang Site, Yiian-Thou, Lin-Thung.
Ä"£>WW (1982),1, pp. 1-7.

Chao Ya-Shu (/) 趙雅書
Mien-Hua Chhuan-Ju Chung-Kuo chih Ching-Kuo 棉花傳入中國之經過
The Stages of the Introduction of Cotton into China.
Shen Tsung-Han & Chao Ya-Shu (/), pp. 222-44.

Chao Ya-shu *(2)* 趙雅書
Sung- Tai Chhen Fu ti Nung-Shu 宋代陳旉的農書
The Book of Agriculture by Chhen Fu of the Sung Dynasty.
SH 食貨
(1976), 6:4, pp. 178-80.

Cheng Thien-Thing (/) 鄭天梃
Kuan-Tit Hsü I-Khuei 'Chih-Kung-Tui' 關於徐一夔織工對
On Hsü I-Khuei's 'Conversations with the Weavers'.
Lsrc (1958), i, pp. 65-76.

Chhen Chih (/) 陳直
San-Fu-Huang Thu Chiao-Cheng 三輔黃圖校証
The *San-Fu-Huang Thu* with Corrections.
Shensi Jen-Min, Sian, 1980.

Chhen Chüan-Chüan (/) 陳娟娟
Liang-Chien Tu Ssu-Chih-Phin Hua- Wen Tin-Hen ti Shang-Tai Wen-Wu 兩件有絲織品花紋印痕的商代文物
Two Patterned Silk Traces on Shang Times Cultural Relics.
WW (1979), 12, pp. 70-1.

Chhen Heng-Li & Wang Ta-Tshan (/) 陳恆力 &王達參
Pu Nung-Shu Ten-Chiu 補農書研究
Research on the *Pu Nung-Shu.*
Chung-Hua, Peking, 1958.

Chhen Heng-Li & Wang Ta-Tshan *(2)* 陳恆力 &王達參
Pu Nung-Shu Chiao-Shih 補農書校釋
Revised and Translated Edition of the *Pu Nung-Shu.*
Nung-Yeh, Peking 1983.

Chhen Hsi-Chhen (/) 陳錫臣
Chung-Kuo ti Ma-Lei Tso- Wu 中國的麻類作物
Chinese Fibre Crops.
Commercial Press, Shanghai, 1952.

Chhen Lien-Chhing (/) 陳連慶
Wm-Shih 文史
History of Literature.
Chung-Hua, Peking, 1983.

Chhen Tsu-Kuei (ed.) (/) 陳祖槼
Mien 棉
Cotton.
Nung-Yeh, Peking, Shanghai, 1957.
Chung-Kuo Nung-Hsüeh I-Chhan Hsüan-Chi: Ti Wu Chung 中國農學遺產選集：第五種

Chhen Yüeh-Chün & Chang Hsii-Chhiu (/) 陳躍鈞 & 張緒球
Chiang-Ling Ma-Chuan I-Hao Mu Chhu- Thu ti Chan-Kuo Ssu-Chih-Phin 江陵馬磚一號墓出土的戰國絲織品
Silk Fabrics of the Warring States Period Unearthed in no. 1 Tomb at Ma-Shan Brickfield in Chiang-Ling, Hupei.
WW (1982), 10, pp. 9-11.

Chheng Ying-Lin & Liu Shih-Chung (/) 程應林 &劉詩中
Kiangsi Kuei-Hsi Ta Mu Fa-Chiieh Chien-Pao 江西貴溪崖墓發掘簡報
Excavation of the Cliff Tombs in Kuei-Hsi County, Kiangsi Province.
WW (1980), 11, pp. 1-25.

ChhuJui-Chhietal. (/) 曲瑞琦
Shen- Tang Hsin-Min-Hsien Kao- Thai-Shan I-Chih 沈陽新民縣高台山遺址
Neolithic Site at Kao-Thai-Shan, Hsin-Min,

Chhüjui-Chhi et. al. (/) *(cont.)*
Shen-Yang.
KK (1982), 2, pp. 121-129.

Chiang Fu-Tsung (éd.) (/) 蔣復璁
Chung-Kuo Shu-Chi Khao Lun-Chi 中國書籍考論集
Collection of Discourses on Chinese Books.
Hong Kong, 1972.

Chiang Tsuan-Chhu (7) 蔣纘初
Kiangsu Hsin-I-Hsien San-Li- Tun I-Chih Shih-Chüeh Chi 江蘇新沂縣三里墩遺址試掘記
Report on the Trial Digging of the Site of San-Li-Tun, Hsin-I County, Kiangsu.
KKTH(i95 8),i,pp. 7-11.

Chiang Yu-Lung (/) 蔣猷龍
Kuan-Tii 'Chhi-Min Yao-Shu' So Tsai Sang Tshan Phhin-Chung ii Chhu-Pu Yen-Chiu 關於"齊民要術"所載桑蠶品種的初步研究
Introductory Research in the Variety of Mulberry Trees and Silkworms Recorded in the *'Chhi Min Yao Shu'.*
Anon *(531)-* Chung-Kuo Ku-Tai Nung-Yeh Kho-Chi 中國古代農業科技
Nung-Yeh, Peking, 1980, pp. 425-35.

Chiang Yu-Lung *(2)* 蔣猷龍
Chung-Kuo Tshan- Yeh Chi-Shu Fa-Chan Kai-Shu 中國蠶業技術發展概述
The Development of Sericultural Techniques in China.
KTY (1982), 1, pp. 46 fr.

Chiang Yu-Lung *(3)* 蔣猷龍
Hsi- Yin- Tshun Pan-Ko Chien-Kho ti Phou-Hsi. 西陰村半個繭壳的剖析
Analysis of the Half-cut Cocoon from Hsi-Yin Village.
TYKH (1982), 1, pp. 39ff.

Chou Khuang-Ming (/) 周匡明
Lei- Tsu Fa-Ming Yang- Tshan Shuo-Khao-I 嫘祖發明養蠶說考異
Research Report on the Peculiarity of how Lei-tsu Invented the Rearing of Silkworms.
KHSCK 科學史集刊
(1965),8, pp. 55-64.

Chou Khuang-Ming *(2)* 周匡明
Chhien-Shan- Yang Tshan-Chiian-Phien Chhu- Thu ti Chhi-Shih 錢山漾殘絹片出土的啓示
Revealing Facts from the Silk Fragments Excavated at Chhien-Shan-Yang.
WW (1980), 1, pp. 74-77.

Chou Khuang-Ming *(3)* 周匡明
Sang-Khao 桑考
Some Notes on Mulberry.
MYKK (1981),1, pp. 108-13.

Chou Khuang-Ming *(4)* 周匡明
Yang-Tshan Chhi-Yuan Wen-Thi ti Yen-Chiu 養蠶起源問題的研究
Research on the Problem of the Origin of Silkworm-rearing.
JVTÄX (1982),1, pp. 133-8.

Chou Khuang-Ming (5) 周匡明
Tshan-Yeh Shih-Hua 蠶業史話
On the History of Sericulture.
Shanghai Kho-Hsüeh Chi-Shu, Shanghai, 1983.
(Chung-Kuo Kho-Chi Shih-Hua Tshung-Shu 中國科技史話叢書)

Chou Shih-Jung (/) 周士榮
Tshan-Sang Wen- Tsunyü Wu-Shih Hsiieh-Hsing Yiieh 蠶桑紋尊與武士靴形鉞
Sericultural Patterns on a Tsun and the Boot-shaped Battle-axe of the Warriors.
^(i979)>6>PP- 5 66"7-

Chou Yao (/) 周堯
Wo-Kuo Ku- Tai I-Chhung Li- Yung Fang-Mien ti Chheng-Chiu 我國古代益蟲利用方面的成就
Achievements of Ancient China in Regard to the Profitable Use of Advantageous Insects to Man.
Anon. *[531). Chung-Kuo Ku-Tai Nung-Yeh Kho-Chi* 中國古代農業科技
Peking, 1980, pp. 152-182.

Chu Fang-Phu (/) 朱芳圃
Chia-Ku-Hsüeh Wen-Tzu-Pien 甲骨學文字編
Oracle-bone Script and Characters (Collected Identifications).
Commercial Press, Shanghai, 1933.

Chu Te-Hsi et al. (/) 朱德熙
Hsin- Yang Chhu-Chien Khao-Shih 信陽楚間考釋
Studies on the Inscribed Bamboo Slips of the Chhu State from Hsin-Yang.
KKHP (1973), i, pp. 121-128.

Chung Kuang-Yen (/) 鍾廣言
Thien-Kung Khai- Wu 天工開物
The *Thien Kung Khai Wu* by Sung Ying-Hsing, translated into colloquial Chinese.
Kuangtungjen-Min, Kuangtung, 1976.

Enoki Kazuo (/) 榎一雄
Shiruku Rödo no Rekishi kara シルクロードの歷史から
From the History of the Silk Road.
Kenbun Shuppan, Tokyo, 1979.

Fan Kuei-Chieh et al., (/) 范桂杰
Wu-Shan Ta-Hsi I-Chih Ti-San- Tzhu Fa-Chiieh 巫山大溪遺址第三次發掘
The Third Season of Excavation at the Ta-Hsi Site in Wu-Shan County.
KKHP (1981), 4, pp. 461-90.

Feng Chhi-Yung & Chou Hung-Hsing (/) 馮其庸 & 周紅興
Shensi Chhang-An-Hsien Wang-Chhü Ti-Chhü Hsin-Shih-Chhi Shih- Tai I-Chih Tiao-Chha 陝西長安縣王曲地區新石器時代遺址調查
Investigation on the Neolithic Sites near Wang-Chhü, Chhang-An County, Shensi Province.
KK (1981),1, pp. 84-7.

Feng Chia-Sheng (7) 馮家昇
Wo-Kuo Fang-Chih-Chia Huang Tao-Pho tui-yii Mien-Chih- Yeh ti Kung-Hsien 我國紡織家黃道婆對於棉織業的貢獻
The Contributions of Our Textile Expert Huang Tao-Pho towards Cotton Industry.

Feng Chia-Sheng (7) *(cont.)*
Li Kuang-Pi & Chhien Chün-Yeh (/), p. 304.

Feng Tse-Fang (/) 馮澤芳
Ckung-Kuo ti Mien-Hua 中國的棉花
Chinese Cotton.
Tshai-Cheng Ching-Chi, Peking, 1956.

Fu Hsi-Hua (comp.), (/) 傅惜華
Han- Tai Hua-Hsiang Chhüan-Chi 漢代畫象全集
Compilation of Stone-relief Pictures from Han Times.
Peking, 1950-1.

Fu I-Ling (/) 傅衣凌
Ming Ckhing She-Hui Ching-Chi Hsing- Tai ti Yen-Chiu 明清社會經濟形態的研究
Research on Ming and Chhing Social and Economic Structure.
Chung-Kuo Jen-Min Ta-Hsüeh, Chung-Kuo Li-Shih Chiao-Yen-Shih (eds.).
Shanghai Jen-Min, Shanghai, 1956; repr., 1982.

Hayashi Minao (5) 林己奈夫
Sengoku Jidai no Gazômon 戦国時代の画象文
Pictorial Designs of the Warring States Period.
Kokogaku Zfisshi 考古学雜誌
>9[61]>47:3-

Ho Chieh-Chiin et al. (/) 何介鈞
Chhang-Sha Tzu- Tan-Khu Chan-Kuo Mu-Kuo-Mu 長沙子彈庫戰國木槨墓
Excavation of the Warring States Wooden Chambered Tomb at Tzu-Tan-Khu, Chhang-Sha.
WW (1974), 2, pp. 37-43.

Hsia Nai (7) 夏鼐
Lin- Thao Ssu- Wa-Shan Fa-Chüeh Chi 臨洮寺窪山發掘記
Excavation Report on the Site of Ssu-Wa-Shan, Lin-Thao County, Kansu.
Chung-Kuo Khao-Ku Hsüeh-Pao 中國考古學報
(1949),4, PP- 71-137-

Hsia Nai *(8)* 夏鼐
Sinkiang Hsin-Fa-Hsien ti Ku- Tai Ssu-Chih-Phin. Chhi Chin ho Tzhu-Hsiu 新疆新發現的古代絲織品綺錦和刺繡
Newly Discovered Finds of Old Silks in Sinkiang; Twill Damask, Brocades and Embroideries.
iHT/H> (1963),1, pp. 45-76.

Hsia Nai (p) 夏鼐
Wo-Kuo Ku- Tai Tshan-Sang Ssu-Chhou ti Li-Shih 我國古代蠶桑絲綢的歷史
The History of Sericulture and Silk Weaving in Our Ancient Times.
KK (1972), 2, pp. 12-27.

Hsia Nai *(10)* 夏鼐
Hsia Nai (p), reprinted in: *Khao-Ku-Hsüeh ho Kho-Chi-Shih* 考古學和科技史
Archaeology and the History of Science and Technology.
Kho-Hsiieh, Peking, 1979, pp. 98-116.

Hsiung Chhuan-Hsin (/) 熊傳新
Chhang-Sha Hsin Fa-Hsien ti Chan-Kuo Ssu-Chih-Wu 長沙新發現的戰國絲織物
Newly Discovered Silk Textiles from the Warring States Period in Chhang-Sha.
WW (1975), 2, PP- 49-5[6]-

Hsü I (/) 許益
Shensi Hua-Hsien Yin- Tai I-Chih Tiao-Chha Chien-Pao 陝西華縣殷代遺址調查簡報
Report on the Yin-sites in Hua County, Shensi.
WW (1957). 3. PP-64-5-

Hsü Shun-Chan (ed.) (/) 許順湛
Tshan-Lan ti Cheng-Chou Shang- Tai Wen-Hua 燦爛的鄭州商代文化
The Splendid Shang Culture of Cheng-Chou.
Honan, 1957.

Hsü Than (/) 許壇
Chung-Kuo Ching-Chi Shih 中國經濟史
Economic History of China.
Shih-Chieh, Taipei, 1969.

Hu Hou-Hsüan *(6)* 胡厚宣
Chan-Hou Ching-Chin Hsin-Huo Chia-Ku-Chi 戰後京津新獲甲骨集
New Postwar Collection of Inscriptions on Tortoise Shells and Bones from Peking and Tientsin.
Shanghai, 1954.

Hu Hou-Hsüan (7) 胡厚宣
Chan-Hou Nan-Pei So-Chien Chia-Ku-Lu 戰後南北所見甲骨錄
A Postwar Catalogue of Inscriptions on Tortoise Shells and Bones Seen in South and North.
Peking, Shanghai, 1951.

Hu Hou-Hsüan *(8)* 胡厚宣
Shang- Tai ti Tshan-Sang ho Ssu-Chih 商代的蠶桑和絲織
Sericulture and Silk-weaving in the Shang Period.
WW (1972), 11, pp. 2-7, 36.

Hu Tao-Ching (ed.) *(4)* 胡道靜
Chung I Pi Yung 種藝必用
Everyman's Guide to Agriculture.
Agriculture Press, Peking, 1963.

Huang Han-Chieh (/) 黃漢傑
Fukien Ching-Hsi Miao-Hou-Shan Ku-Mu Chhing-Li 福建莆溪廟后山古墓清理
Clearing of the Ancient Tomb of Miao-Hou-Shan, Ching-Hsi, Fukien.
*"^(i959),6, PP- 282-4.

Huang Hsüan-Phei & Chang Ming-Hua (/)
黃宣佩 & 張明華
Chhing-Phu-Hsien Sung- Tse I-Chih Ti-Erh- Tzhu Fa-Chüeh 清浦縣崧澤遺址第二次發掘
The Second Season of Excavation at Sung-Tse Site in Chhing-Phu County, Shanghai.
KKHP (.980),., pp. 29-58.

Huang Kuo-Liang (/) 黃國梁
Wo-Kuo Ku- Tai Ta-Fang-Chhe ti Chhan-Shengyii Fa-Chan 我國古代大紡車的產生與發展
The Emergence and Development of the 'Big Spinning Frame' in Our Past.
HTFCKHYHP (1981), 3, pp. 185-91.

Ikeda Suetoshi (/) 池田末利
Inkyo Shokei Koken Shakubun Ko 殷虛書契後編釈文考
Investigation into the Explanation of Shang-Yin Oracle-bones.
Hiroshima, 1964.

Ishimori Naoto (/) 石森直人
Kaiko 蠶
Silkworms.
Iwanami Shoten, Tokyo, 1942.

Itô Toshio (ed.) (/) 伊藤敏雄
Kasan Seikagaku 家蚕生化学
The Biochemistry of the Silkworm.
Tokyo, 1984.

Jao Hui-Yüan (/) 饒惠元
Kiangsi Chhing-Chiang ti Hsin-Shih-Chhi Shih- Tai /-Chih 江西清江的新石器時代遺址
The Neolithic Sites of Chhing-Chiang, Kiangsi.
KKHP(i$_{95}$6), a, pp. 33-68.

Jung Keng *{3)* 容庚
Chin-Wen-Pien 金文編
Bronze Forms of Characters.
1925; rev. ed. repr., Peking, 1959.

Kao Chih-Hsi *(2)* 高至喜
Chhang-Sha Lieh-Shih Kung-Tüan San-Hao Mu-Kuo-Mu Chhing-Li Chien-Pao 長沙烈士公園 3 號木槨墓清理簡報
A Brief Report about the Clearing of the Wood-coffin Tomb no. 3 in the Public Park of Heroes in Chhang-Sha.
WW (1959), 10, pp. 65-70.

Kao Chih-Hsi *(3)* 高至喜
Hunan Ku- Tai Mu- Tsang Kai-Khuang 湖南古代墓葬概況
Survey on Ancient Tombs of Hunan.
WW (i960), 3, pp. 33-7.

Kao Han-Yü (/) 高漢玉
Thai-Hsi- Tshun Shang- Tai I-Chih Chhu- Thu ti Fang-Chih-Phin 台西村商代遺址出土的紡織品
Textiles Excavated form the Shang Site of Thai-Hsi-Tshun, Kao-Chheng, Hopei.
WW (1979), 6, pp. 44-8.

Kao Han-Yü *(2)* 高漢玉
Tshung Chhu- Thu Wen- Wu Chui-Su Tshan-Ssu- Teh ti Chhi-Yüan 從出土文物追溯蠶絲業的起源
Tracing the Origin of Sericulture from Archaeo-logical Relics.
TSTP 蠶桑通報.(1981), 1, pp. 17-24.

Kao Han-Yü & Shih Pai-Khuei (/) 高漢玉 & 史伯奎
Chung-Kuo Ku- Tai ti Fang-Chhe ho Chih-Chi 中國古代的紡車和織機
Spindle-wheels and Looms of Ancient China.
Anon. *(641). Chung-Kuo Ku-Tai Kho-Chi Chheng-Chiu* 中國古代科技成就
Achievements of Ancient Chinese Science and Technology.
Kho-Hsüeh, Peking, 1978, pp. 632—44.

Kao Ying-Chhin (/) 高應勤
Hupei Huang-Shih-Shih Liu-Chhu Ku I-Chih Tiao-ChhaChi-Tao 湖北黃石市六處古遺址調查紀要
Investigation of Six Sites of Huang-Shih City in Hupei.
WW (1956),12, pp. 49-52.

Ko Chin (/) 葛今
Ching-Tang Kao-Chia-Pao Tsao-Chou Mu-Tsang Fa-Chüeh Chi 涇陽高家堡早周墓葬發掘記
Account of the Examination of an Early Chou Tomb at Kao-Chia-Pao.
WW (1972), 7, pp. 5-7.

Kuo Mo-Jo (ed.) *{13)* 郭沫若
Chung-Kuo Shih-Kao Ti- Thu-Chi 中國史稿地圖集
Historical Atlas of China.
Shanghai, 1979, 2 vols.

Kuo Mo-Jo *(14)* 郭沫若
Yin-Chhi Tshui-Pien 殷契粹編
Collection of Inscriptions of the Yin Period.
Tokyo, 1937; rev. ed. Peking, 1959; repr. Taipei, I97I-

Kuo Mo-Jo et al. (eds.), (/5) 郭沫若
Kuan- Tzu Chi-Chiao 管子集校
Compilation of the Book of Master Kuan.
Shanghai, 1956.

Kuo Pao-Chün *(3)* 郭寶鈞
ig$o Mien Chhun Tin-Hsü Fa-Chüeh Pao-Kao !95° 年春殷墟發掘報告
Report on the Excavation of Yin-Hsü in the Spring of 1950.
KKHP (1950,5. PP- 1-61.

Kuo Pao-Chün *(4)* 郭寶鈞
Lo-Tang Chien Pin Ku-Wen-Hua I-Chih chi Han-Mu 洛陽澗濱古文化遺址及漢墓
Early Dwelling Sites and Han Tombs Excavated at the Valley of Chien River, Loyang.
KKHP (i$_{95}$6),i, pp. 11-28.

Kuo Pao-Chün (5) 郭寶鈞
/954 *Mien Chhun Lo- Tang Hsi-Chiao Fa-Chüeh Pao-Kao* 1954年春洛陽西郊發掘報告
Excavation in the Western Suburb of Loyang in the Spring of 1954.
KKHP (i$_{95}$6), 2, pp. 1-31.

Kuo Yuan-Wei & Li Chia-Ho (/) 郭遠謂 & 李家和
Kiangsi Wan-Mien, Ta- Tüan, Hsien-Jen- Tung Tung-Hsüeh I-Chih Shih-Chiieh 江西萬年大源仙人洞洞穴遺址試掘
Trial Diggings at the Neolithic Site of Hsien-Jen-Tung, Ta-Yuan, Wan-Nien, Kiangsi Province.
KKHP (1963), 1, pp. 1-16.

Li Chhang-Nien (comp.) *(2)* 李長年
Chung-Kuo Mung-Hsüeh I-Chhan Hsiian-Chi Ma-Lei Tso-Wu 中國農學遺產選集麻類作物
Works on the Species Ma; Fibre Crops; Antho-logy of Quotations [Illustrating the History of] Chinese Agricultural Science and Production.

Li Chhang-Nien (comp.) *(2) (cont.)*
Chinese Agricultural Heritage Series A, no. 8., vol. 1.
Nung-Yeh, Peking, 1962.

Li Chhang-Nien *(3)* 李長年
Chhi-Min Yao-Shu Ten-Chiu 齊民要術研究
A Study of the *Chhi Min Yao Shu.*
Nung-Yeh, Peking, 1959.

Li Chhang-Nien (j) 李長年
Nung-Sang-Ching Chiao-Chu 農桑經校注
Revised and Annotated Edition of the *Nung Sang Cking.*
Nung-Yeh, Peking, 1982.

Li Chhang-Nien (6') 李長年
Nung-Yeh Shih-Hua 農業史話
On the History of Agriculture.
Shanghai Kho-Hsüeh Chi-Shu, Shanghai, 1981.
(Chung-Kuo Kho-Chi Shih-Hua Tshung-Shu 中國科技史話叢書.

Li Chhung-Chou *(2)* 李崇州
Shih-Chieh Shang Tsui- Tsao ti Shui-Li Fang-Chi-Chhe Shui Chuan Ta Fang Chhe 世界上最早的水力紡績車"水轉大紡車".
The World's Oldest Water-powered Spinning Machinery—the 'Great Water-driven Spinning Machine'.
WW (1959). ", pp-29-3°-

Li Chhung-Chou *(3)* 李崇州
Wo-Kuo Ku- Tai ti Chiao- Tha Fang-Chhe 我國古代的腳踏紡車
The Treadle-operated Spindle-wheel of Our Ancient Times.
WW(1977), 12, pp. 73-5.

Li Chi (/) 李濟
An- Yang Fa-Chüeh Pao-Kao 安陽發掘報告
Report on the Excavation of Anyang.
Academia Sinica, Peking 1929, vols. 1 and 2.
Peking, 1931, vol. 3.
Shanghai, 1931-3, vol. 4.

Li Chi *(2)* 李濟
Hsi- Yin- Tshun Shih-Ckhien ti /- Tshun 西陰村史前的遺存
Prehistoric Remains at Hsi-Yin-Tshun.
Peking, 1927.

Li Chien-Nung (5) 李劍農
Sung Yuan Ming Ching-Chi Shih-Kao 宋元明經濟史稿
An Economic History of the Sung, Yuan and Ming Dynasties.
San-Lien, Peking, 1957.

Li Ching-Tan (/) 李景聃
Yii- Tung Shang-Chhiu Yung-Chheng Tiao-Chha chi Tsao-Lü- Thai, Hei-Ku- Tui, Tshao-Chhiao San-Chhu Hsiao Fa-Chüeh 豫東商邱永城調查及造律台黑孤唯曹橋三處小發掘
Archaeological Survey of the Districts of Shang-Chhiu and Yung-Chheng in Eastern Honan and Reports on the Excavations of Tsao-Lü-Thai, Hei-Ku-Tui and Tshao-Chhiao.
CKKHP 中國考古學報.
(1947), **2**, pp. 83–120.

Li Fu-Hua (/) 李復華.
Chheng- Tu Chhing- Yang-Kung Ku I-Chih Chhing-Li Chien-Pao 成都青羊宮古遺址清理簡報
Report on the Clearing of the Ancient Tomb of Chhing-Yang-Kung at the Chin River, Chheng-Tu.
KKTH (1956), a, pp. 43-6.

Lijen-Phu(z) 李仁溥
Chung-Kuo Ku- Tai Fang-Chih Shih-Kao 中國古代紡織史稿
Textile History of Ancient China.
Yiieh-Lu, Chhang-Sha, 1983.

Li Kuang-Pi & Chhien Chün-Yeh (eds.) (/) 李光璧 & 錢君曄
Chung-Kuo Kho-Hsüeh Chi-Shu Fa-Ming ho Kho-Hsüeh Chi-Shu Jen- Wu Lun-Chi 中國科學技術發明和科學技術人物論集
Essays on Chinese Discoveries and Inventions in Science and Technology, and on the People who Made them.
San-Lien, Peking, 1955.

Li Ya-Nung (/) 李亞農
Yin- Tai She-Hui Sheng-Huo 殷代社會生活
Social Life in Shang Times.
Jen-Min, Shanghai, 1955.

Li Yang-Sung *(ij* 李仰松
Yünnan-Sheng Wa- Tsu Chih- Thao Kai-Khuang 雲南省瓦族製陶概況
Pottery Making among the Wa of Yunnan.
No Place, 1958.

Li Yeh-Chen & Chang Hung-Yuan (/) 李也貞 & 張宏源
Yu-Kuan Hsi-Chou Ssu-Chih ho Tzhu-Hsiu ti Chung-Yao Fa-Hsien 有關西周絲織和刺繡的重要發現
Concerning an Important Discovery of Western Chou Siik and Embroidery Impressions on Mud.
WW (1976), 4, pp. 60-3, col. pi. 1.

Liang Ssu-Yung et al. (/) 梁思永
Hou-Chia-Chuang Ti Erh Pen 1001 Hao Ta-Mu 侯家莊第二本1001號大墓
Hou-Chia-Chuang the Yin-Shang Cemetery Site at Anyang, Honan, vol. 2: *HPKM* 1001.
Taipei, 1962.

Liang Ssu-Yung et al. *(2)* 梁思永
Hou-Chia-Chuang Ti Liu Pen 121 y Hao Ta-Mu 侯家莊第六本1217號大墓
Hou-Chia-Chuang the Yin-Shang Cemetery Site at Anyang, Honan, vol. 6: *HPKM* 1217.
Taipei, 1968.

Liang Ssu-Yung et al. (5) 梁思永
Hou-Chia-Chuang Ti Wu Pen 1004 Hao Ta-Mu 侯家莊第五本1004號大墓
Hou-Chia-Chuang the Yin-Shang Cemetery Site at Anyang, Honan, vol. 5: *HPKM* 1004.
Taipei, 1970.

Ling Man-Li (/) 凌曼立
Taiwanyü Huan Thai-Phing-Yang ti Shu-Phi-Pu Wen-Hua 台灣與環太平洋的樹皮布文化.
Bark-cloth in Taiwan and the Circum-Pacific

Ling Man-Li (/) *(cont.)*
Areas.
Ling Shun-Sheng (7), pp. 211-57.

Ling Shun-Sheng (7) 凌純聲
Shu-Phi-Pu Tin- Wen- Thao yii Tsao Chih Tin-Shua-Shu Fa-Ming 樹皮布印文陶與造紙印刷術發明
Bark-cloth, Impressed Pottery, and the Inventions of Paper and Printing.
Taipei, 1963.
(Chung-Yang Yen-Chiu-Yüan Min-Tsu-Hsüeh Yen-Chiu-So 中央研究院民族學研究所•30

Ling Shun-Sheng *(13)* 凌純聲
Chung-Kuo Ku- Tai ti Shu-Phi-Pu- Wen-Huayü Tsao-Chih-Shu Fa-Ming 中國古代的樹皮布文化與造紙術發明
Bark-cloth Culture and the Invention of Paper-making in Ancient China.
Ling Shun-Sheng (7), pp. 29-49.

Liu Chia-Chi & Liu Ping-Sen (/) 劉家驥 & 劉炳森
Chin-Chhüeh-Shan Hsi-Han Po-Hua Lin-Mo Hou-Kan 金雀山西漢帛畫臨摹後感
Further Thoughts on the Copies of the Silk Paintings from Chin-Chhüeh-Shan of the Western Han Period.
WW (1977), 11, pp. 28-31.

Liu Chih-Yüan (/) 劉志遠
Szechwan Han- Tai Hua-Hsiang-Chuan Fan- Ting ti She-Hui Sheng-Huo 四川漢代畫像磚反映的社會生活
Life in the Eastern Han Society as Reflected in the Decorated Tomb Bricks of the Han Tomb in Szechwan.
WW (1975), 4, pp. 45-55, pi. 1:2.

Liu Chhing-Chu & Chhen Kuo-Ying (/) 劉慶柱 &陳國英
Chhin- Tu Hsien- Tang Ti-I-Hao Kung- Tien Chien-Chu I-Chih Chien-Pao 秦都咸陽第一號宮殿建築遺址簡報
Excavation of the Architectural Remains of the Palace no. 1 at the Chhin Capital Hsien-Yang.
WW (1976), 11, pp. 12-24, 41.

Liu Ho-Hui (/) 劉和惠
Kuan- Tu Chung-Kuo Li-Shih Shang Mien-Fang-Chih Sheng-Chhan Kung-Chii ti Chi Ko Wen- Thi 關於中國歷史上棉紡織生產工具的幾個問題
Concerning a Few Problems of Devices in the Cotton Industry in the History of China.
Kuang-Ming Jih-Pao 光明日報,24.7.1961.

Liu Hsien-Chou (j) 劉仙州
Chung-Kuo Tsai Chhuan- Tung Chi-Chien Fang-Mien ti Fa-Ming 中國在傳動機件方面的發明
Chinese Inventions in Power Transmission.
KCHP 工程學報
(Chhing-Hua Engineering Reports) 2:1 (1954), p. 152:2 (1954), p. 219.

Liu Hsien-Chou (7) 劉仙州
Chung-Kuo Chi-Chiek Kung-Chheng Fa-Ming-Shih 中國機械工程發明史
A History of Chinese Engineering Inventions.
Kho-Hsüeh, Peking, 1962.

Liu Wen-Tien (/) 劉文典
Chuang Tzu Pu-Cheng 莊子補正
The Text of Chuang Tzu, Annotated and Corrected.
Commercial Press 1939, Shanghai 1947.

Lo Chen-Yü *(4)* 羅振玉
Tin-Hsü Shu-Chhi Chhien-Pien 殷虛書契前編
Inscriptions on the Shang Oracle Bones. Earlier Compilation.
1912; repr., Shanghai, 1932.

Lo Chen-Yü (j) 羅振玉
Thieh- Tun Tshang-Kuei chih Tii 鐵雲藏龜之餘
Remainder of the Thieh-yün Tortoise Shell Collection.
1915; repr., Hong Kong, 1972.

Lo Chen-Yü (6") 羅振玉
Tin-Hsü Shu-Chhi Hou-Pien 殷虛書契後編
Inscriptions on Shang Oracle Bones. Later Compilation.
(1916).

Lo Chen-Yü (7) 羅振玉
Tseng-ting Tin-Hsü Shu-Chhi Khao-Shih 增訂殷虛書契考釋
Revised and Enlarged Investigation and Explanation to Inscriptions on Shang Oracle Bones.
Lo Hsüeh- Thang Hsien-Sheng Chhüan-Chi 羅雪堂先生全集
Complete Works of Mr Lo Hsüeh-Thang.
orig. ed., 1927; repr., Taipei, 1968-9, vol. 46.

Lo Chen-Yü *(8)* 羅振玉
Tin-Hsü Shu-Chhi Hsü-Pien 殷虛書契續編
Inscriptions on Shang Oracle Bones. Continued Compilation.
('933)-

Lo Shao-Wen (/) 羅紹文
Sinkiang Tshan-Teh-Shih Kai-Shu 新疆蠶業史概述
A General Outline of the History of Sericulture in Sinkiang.
TTKH (1982), 1, pp. 41 ff.

Lü Min-Chi (/) 呂民基
Fang-Chih Ming-Tzhu Tzjtu-Tien 紡織名詞辭典
Dictionary of Textile Fields.
Wu-Chou, Taipei, 1964.

Ma Te-Chih (/) 馬得志
'953 Nien An- Tang Ta-Ssu-Khung- Tshun Fa-Chüeh Pao-Kao 1953年安陽大司空村發掘報告
Report on the Excavation of Ta-Ssu-Khung-Tshun, Anyang in 1953.
KKHP (1955), 9, pp. 25-40.

Mao Tso-Pen (/) 茅左本
Wo-Men Tsu-Hsien ti Chhuang- Tsao Fa-Ming 我們祖先的創造發明

Mao Tso-Pen (/) *{cont.)*
The Products and Iventions of Our Ancients. Shanghai Jen-Min, Shanghai, 1957.

Maeda Yukichika (/) 前田千寸
Nihon Shikisai Bunka Shi 日本彩色文化史
Japanese Cultural History in Colour. Iwanami, Tokyo, i960.

Ming I-Shih (J. M. Mencius) (/) 明義士
Tin-Hsü Pu- Tzhu 殷虚卜辭
Shang Oracle Bones and Their Inscriptions. (1917)-

Mo Chih (/) 莫稚
Kuangtung Pao-An Hsin-Shih-Chhi Shih- Tai I-Chih Tiao-Chha Chien-Pao 廣東寶安新石器時代遺址調查簡報
Report on the Investigation of the Neolithic Site of Pao-An, Kuangtung Province. /T/rrr/(1957), 6, pp. 8-15.

Mu Chhi-Yü (/) 繆啓愉
Ssu-Shih Tsuan-Tao Chiao-Shih 四時纂要校釋
Explanations to the Collection of Essentials of the Four Seasons by Han O 韓鄂 of Thang Times.
Nung-Yeh, Peking, 1981.

Mu Chhi-Yu (2) 繆啓愉
Chhen Fu Nung-Shu Hsüan- Tu 陳勇農書選讀
A Reader of the *Nung Shu* by Chhen Fu.
Nung-Yeh, Peking, 1981.

Mu I-Chhin (/) 穆益勤
Sung-Jen 'Nü-Hsiao-Ching Thu' Chüan ti Tso-Hua Mien- Tai 宋人"女孝經圖"卷的作畫年代
The Period when the Sung Scroll 'Canon of Female Piety' was Made.
KKPWYYK 故宮博物院院刊 二
(1960),3, pp. 182-3.

Nagahiro Toshio (/) 長広敏雄
Kandai Gazō no Kenkyü 漢代画象の研究
The Representational Art of the Han Dynasty. Chüö-Köron Bijutsu Shuppan, Tokyo, 1965.

Nagasawa Kazutoshi (/) 長沢和俊
Shiruku Redo Shi Kenkyü シルクロード史研究
Historic Studies of the Silk Road. Kokusho Kankökai, Tokyo, 1979.

Nunome Junrô (/) 布目順郎
Tosan no Kigen to Kodai Kinu 養蚕の起源と古代絹
The Origin of Sericulture and Silk Fabrics from Ancient Times.
Yüzankaku, Tokyo, 1979.

Nunome Junrô *(s)* 布目順郎
Kinuseni Ibutsu no Kenkyü—Sanshigyö Gijutsu no Kanten kara 絹繊維遺物の研究—蚕糸業技術の観点から—
Studies on the Silk Fibres as Remains—From the Viewpoint of Sericultural Technique. Kyoto, 1967.

Nunome Junrô (5) 布目順郎
Shichü no Michi (Silk-Road) no Ichi Kojôshi de Hakkutsu Sareta Todai Mayugara ni Kansuru Ichikösatsu 絲絹之路(シルクロード)の一古城址で発掘された唐代繭殻に関する一考察
An Aspect on the Cocoon Shell of Thang Period Excavated from the Ruins of an Old Castle along the Silk Road.
Nihon Sanshigaku Zasshi 日本蚕糸学雑誌
(i973)»4»'-2>PP- 178-83.

Nunome Junrô *(4)* 布目順郎
Senshin Jidai no Kinuseni Oyobi Sonota Seni ni Tsuite 先秦時代の絹繊維およびその他繊維について
On Silk Fibres and Other Fibres before Chhin Dynasty.
Kyoto Kögei Seni Daigaku Seni Gakubu Gakujutsu Hokoku 京都工芸繊維大学繊維学部学術報告
(i973).7:[.PP- 74-95:
MZ 日本蚕糸学雑誌
([1973).44:5»PP- 381-388.

Nunome Junrô (j) 布目順郎
Sengoku Gazômon ni Mirareru Saisôgu ni Tsuite—Rei to no Kanren ni Oite 戦国画像紋にみられる採桑具について一礼との関連において
On Mulberry-leaf Picking Tools in the Graphic Designs Seen on the Surface of Bronze Receptacles of the Warring States Period of China-with Special Reference to the Ceremony.
NSZ 日本蚕糸学雑誌
(1973). 42:4» PP-3°°-3o8.

Nunome Junrô *(6)* 布目順郎
Shansi-Sheng Hsi-Tin-Tshun Shutsudo no Yang-Shao Ki Mayugara ni Tsuite 山西省西陰村出土の仰韶期繭殻
On the Cocoon Shell of Yang-shao Age Excavated at Hsi-Yin-Tshun, Shansi.
MZ 日本蚕糸学雑誌
(1968),37:2. PP- '87-'94-

Ohta Eizö *(2)* 太田英蔵
Kodai Chügoku no Shokki Gijutsu 古代中国の織機技術
The Technology of Looms in Ancient China.
Shirin 史林
(1951). 34=1. PP-63-77-

Ohta Eizö *(3)* 太田英蔵
Tsukinowa Kqfun 月の輪古墳
Tsukinowa, the Ancient Burial Mound, a Report of Our Excavation.
Yanahara, Okayama, i960, pp. 192-220.

Ohta Eizö *(4)* 太田英蔵
Orimono 織物
Weaving.
KSK (1966), 13, p. 274.

Omura Seinosuke (/) 大村清之助
Sösan no Seitai Shüsei Oyobi Mayu ni Kansuru Chösa 桑蚕の生態習性滅び繭に関する調査
Investigation on the Evolution of Silkworms and

Ömura Seinosuke *(i) (cont.)*
Cocoons.
SSHK 蚕糸試驗場報告
(195°). »3'3>PP- 7 9 - ^ -

PhengTse-I (ed.) (/) 彭澤益
Chung-Kuo Chin- Tai Shou-Kung- Yeh-Shih Tzu-Liao '840-1949 中國近代手工業史資料 1840-1949.
Materials for the Study of Chinese Craftsmanship in Modern Times 1840—1949.
Peking, 1957.

Pheng Tse-1 *(2)* 彭澤益
Chhing- Tai Chhien-Chhi Chiang-Nan Chih- Tsao ti Ten-Chiii 清代前期江南織造的研究
Research on the Kiangnan Silk Weaving Factories in the Early Chhing Period.
LSrC (1963), 4, pp. 91-116.

Pheng Tse-I (3) 彭澤益
Tshung Ming- Tai Kuan- Ting Chih- Tsao ti Ching-Ting Fang-Shih Khan Chiang-Nan Ssu-Chih- Teh Sheng-Chhan ti Hsing-Chih 從明代官營織造的經營方式看江南絲織業生產的性質
Looking at the Nature of the Kiangnan Silk Weaving Industry's Production from the Commercial Practices of the Ming Dynasty Government-sponsored Silk-weaving Factories.
/.51-0-(1963),3^.33-56.

Pheng Tse-I *(4)* 彭澤益
Ta-Phien Chan-Cheng Chhien Chhing- Tai Su-Chou Ssu-Chih-Teh Sheng-Chhan Kuan-Hsi ti Hsing-Shihyii Hsing-Chih 鴉片戰爭前清代蘇州絲織業生產關係的形式與性質
The Structure and Nature of the Productive Relations in the Suchou Silk Weaving Industry in the Chhing Period before the Opium War.
cere (1963), 10, pp. 63-73.

Saeki Yüichi (/) 佐伯有一
Min ^enhanki no Hataya 明前半期の機屋
Silk Weavers during the First Half of the Ming.
TBKK (1956), 8, 167-210.

Saeki Yüichi *(2)* 佐伯有一
Mindai Shöekisei no Hökai to Toshi Kinuorimonogyö no Ryûtsûshijô no Tenkai 明代匠役制の崩壊と都市絹織物業の流通市場の展開
The Collapse of the System of Government-employed Artisans and the Development of Silk Markets in Chinese Cities.
TBKK (1956), 10, pp. 359-425-

Saeki Yüichi *(3)* 佐伯有一
Minmatsu Shokkö Bodo Shiryö Ruishü 明末織工暴動史料類輯
Concerning the Revolt of Weavers in Suchou in the Early Part of the 17th Century.
Mindai-Shi Ronso 明代史論叢
Tokyo, 1962, pp. 611-35.

Saeki Yüichi *(4)* 佐伯有一
1601 Nen 'Shokuyo no Hen' 0 Meguru Shomondai 1601年「織傭之変」をめぐる諸問題
Problems of the Silk-weaving Craftsmen's Revolt of 1601 in Suchou.
TBKK (1968), 45, pp. 77-108.

Sasaki Shinzaburô (/) 佐々木信三郎
Ragi Shikô 羅技私考
My Opinion about Gauze Technology.
Kawashima Orimono Kenkyüsho Hökoku 川島織物研究所報告
Reports of the Research Institute of Kawashima Orimono, 5.
Kyoto, i960.

Sasaki Shinzaburô *(2)* 佐々木信三郎
Shösöin no Ra 正倉院の羅
Patterned Ra-weave Fabrics in the Shösöin.
Nihon Keizai Shimbunsha, Tokyo, 1971.

Satö Taketoshi (/) 佐藤武敏
Chügoku Kodai Kinu Orimono Butsu Shi Kenkyü 中国古代絹織物史研究
Research in the Textile History of Ancient China.
Kazama Shobö, Tokyo, 1977.

Sekino Tadashi & Takeshima Takuichi (/) 関野貞 & 竹島卓一
RyS-Kin Jidai no Kenchiku to Sono Butsuzo 遼金時代の建築と其仏像
The Architecture and Buddhist Images of the Liao and Chin Periods.
Ryümun, Tokyo, 1944.

Sha Pi-Thi (/) 沙比提
Tshung Khao-Ku Fa-Chüeh Tzu-Liao Khan Sinkiang Ku- Tai ti Mien-Hua Chung-Chih ho Fang-Chih 從考古發掘資料看新疆古代的棉花種植和紡織
Cotton Planting and Weaving in Ancient Sinkiang in the Light of Archaeological Data.
WW (1973), 10, pp. 48-51.

Shen Tsung-Han & Chao Ya-Shu (/) 沈宗瀚 & 趙雅書
Chung-Hua Nung- Teh-Shih—Lun-Chi 中華農業史一論集
Collected Essays on the History of Chinese Agriculture.
Commercial Press, Taipei 1979.

Shiba Yoshinobu (/) 斯波義信
Sôdai Shôgyô Shi Kenkyü 宋代商業史研究
Commerce and Society in Sung China.
Kazama Shobö, Tokyo, 1968.

Shih Chang-Ju (/) 石璋如
Hsin-Shih-Chhi Shih- Tai ti Chung- Tiian 新石器時代的中原
The Neolithic Age in the Mainland of China.
7XTC (1962), 4:3, p. 68.

Shih Hung-Ta (/) 史宏達
Shih-Lun Sung Tiian Ming San- Tai Mien-Fang-Chih Sheng-Chhan Kung-Chü Fa-Chan-Shih Kuo-Chheng 試論宋元明三代棉紡織生產工具發展史過程
Discussion of the Development of Implements and Machinery for Cotton Manufacture in Sung, Yuan, and Ming Times.

Shih Hung-Ta (/) *(cont.)*
LSYC {1957),3, pp. 19-42.
Shih Min-Hsiung (7) 施敏雄
Chhing-Tai Ssu-Chih Kung-Teh ti Fa-Chan 清代絲織工業的發展
The Silk Industry in Chhing China.
Taipei, 1968. .
Shih Sheng-Han *(3)* 石聲漢
Chhi-Min Yao-Shu Chin-Shih 齊民要術今釋
Modern Explanations of the Important Arts for the People's Welfare.
Science Press, Peking, 1957-8; 4 vols, in one.
Shih Sheng-Han (5) 石聲漢
Liang Han Mung-Shu Hsüan- Tu 兩漢農書選讀
Selected Readings from Two Han Agricultural Works.
Agriculture Press, Peking, 1979.
Shih Sheng-Han (7) 石聲漢
Chung-Kuo Ku- Tai Mung-Shu Phing-Chieh 中國古代農書評介
A Review of Agricultural Books of Ancient China.
Nung-Yeh, Peking, 1980.
Shih Sheng-Han (ed.) (5) 石聲漢
Nung-Cheng Chhüan-Shu Ckiao-Chu 農政全書校注
Revised and Annotated Edition of the *NCCS.*
Ku-Chi, Shanghai, 1979, 3 vols.
Shih Sheng-Han *(g)* 石聲漢
Chhi-Min Tao-Shu Hsüan Tu-Pen 齊民要術選讀本
Selections from the *Chhi Min Yao Shu.*
Shanghai, 1961.
Shih Sheng-Han *(10)* 石聲漢
Shih-Lun Wo-Kuo Jen-Min Tsui- Tsao tui Kan-Che yü Mien-Hua ti Li- Yung 試論我國人民最早對甘蔗與棉花的利用
Earliest References to Sugarcane and Cotton in China.
HPNHYHP (1958), 1, pp. 45-54-
Shih Sheng-Han (//) 石聲漢
Nung-Sang Chi- Yao Chiao-Chu 農桑輯要校注
Revised and Annotated Edition of the *Hung Sang Chi Yao.*
Nung-Yeh, Peking, 1982.
Shih Sheng-Han & Khang Chheng-I (eds.) (/) 石聲漢 & 康成懿
Pien-Min Thu-Tsuan 便民圖纂
Collection of Pictures for Ordinary People.
Nung-Yeh, Peking, 1959, repr. 1982.
Shima Kunio (2) 島邦男
Inkyo Bokuji Sôrui 殷墟卜辭綜類
Compendium on the Shàng Oracle Bones and Their Inscriptions.
Tokyo, 1967; repr., Taipei, 1970.
Shima Kunio *(3)* 島邦男
Zôtei Inkyo Bokuji Sôrui 增訂殷墟卜辭綜類
Revised and Enlarged Compendium on the Shang Oracle Bones and Their Inscriptions.
Taian Shoten, Tokyo, 1977.
Shinoda Osamu & Tanaka Seiichi (/) 篠田統 & 田中靜一
Chügoku Shokkei Sosho 中国食経叢書
A Collection of Chinese Dietary Classics.
Shoseki Bunbutsu Ryütsükai, Tokyo, 1973.
Shirakawa Shizuka (/) 自川靜
Kanji—Oitachi to Sono Haikei 漢字—生い立ちとその背景
Chinese Characters—Origin and Background.
Iwanami Paperback 747, Tokyo, 1970.
Sudô Yoshiyuki *(4)* 周藤吉之
Sôdai Keizaishi Kenkyü 宋代経済史研究
Research on the History of Sung Economy.
Tokyo Daigaku Shuppan, Tokyo, 1962, 1971.
Sun Hai-Po (/) 孫海波
Chia-Ku Wen-Pien 甲骨文編
The Compilation of Inscriptions on Oracle Bones and Shells.
Peking, 1934; repr., Peking, 1965.
Sun Yü-Thang (/) 孫毓棠
Chan-Kuo Chhin-Han Shih- Tai Fang-Chih Chi-Shu ti Chin-Pu 戰國秦漢時代紡織技術的進步
On the Advancement of Textile Technology during the Warring States, Cbhin and Han Periods.
LSYC (1963), 3, pp. 143-73.
Sung Chan-Chhing (/) 宋湛慶
Wo-Kuo Ku- Tai ti Ta-Ma Sheng-Chhan 我國古代的大麻生產
Hemp Production in Ancient China.
C O « (1982), 2, pp. 48-57.
Sung Chao-Lin (/) 宋兆麟
Yunnan Hsi-Shuang-Pan-Na Thai- Tsu ti Fang-Chih Chi-Shu—Chien- Than Ku- Tai Fang-Chih ti Chi Ko Wen-Thi 雲南西雙版納傣族的紡織技術—兼談古代紡織的幾個問題
The Weaving Techniques of the Thai National-1 ity of Hsi-Shuang-Pan-Na, Yunnan Province and some Problems of Textile Weaving in Antiquity.
WW (1965), 4, pp. 6-13.
Sung Po-Yin & Li Chung-I (/) 宋伯胤 & 黎忠義
Tshung Han Hua-Hsiang-Shih Than-Suo Han- Tai Chih-Chi Kou- Tsao 從漢畫象石探索漢代織機構造
Loom Construction after the Research of Stone-reliefs from Han Times.
WW (1962), 3, pp. 24-30, 44.
Suzuki Saburô (/) 鈴木三郎
(transi. Tsou Ching-Heng) 鄒景衡
Sao-Ssu-Hsüeh 繅絲學
Silk-reeling Technology.
Hsü-Shih Chi-Chin, Taipei, 1977.

Tang Hua (/) 黨華
Erh-Mien-Lai Chekiang Fa-Hsien ti Hsin-Shih-Chhi Shih- Tai I-Chihyü I- Wu 二年來浙江發現的新石器時代遺址與遺物
The Neolithic Sites and Remains Excavated in the Two Years Past in Chekiang.
WW (1955), 8, pp. 68-84.

Than Tan-Chhiung (/) 譚旦冏
Chung-Hua Min-Chien Kung-I Thu-Skuo 中華民間工藝圖說
Illustrations and Explanations of Chinese Popular Crafts.
Chung-Hua Tshung-Shu, Taipei, 1956.

Thang Yün-Ming (/) 唐雲明
Hsing- Thai Nan- Ta-Kuo- Tshun Shang- Tai I-Chih Than-Chiieh Chien-Pao 邢台南大郭村商代遺址探掘簡報
Trial Digging at the Shang Site of Nan-Ta-Kuo-Tshun, Hsing-Thai, Hopei.
WW (1957), 3, pp. 61-63.

Tonaki Akira (/) 渡名喜明
Chijuka no Bashôfu 喜如嘉の芭蕉布
Banana Cloth from Chijuka, Okinawa.
Kodansha, Tokyo, 1977. Ningen Kokuhô Shirizu 人間国宝シリーズ 41.

Tshai Ching-Feng & Li Hsi-Pi (/) 蔡景峰 & 李希泌
Chung-Kuo Ku- Tai Kho-Hsüeh-Chia ti Ku-Shih 中國古代科學家的故事
Stories of Scientists in Ancient China.
Peking, 1978.

Tshao Theng-Fei (/) 曹騰騑
Chhen Chhi-Tiian ho Chi-Chhang-Lung Sao-Ssu-Chhang 陳啟源和繼昌隆繅絲廠
Chhen Chhi-Yüan and the Chi-Chhang-Lung Silk Filature.
WWTT (1983), 5, pp. 11-13.

Tsou Ching-Heng (/) 鄒景衡
Lieh-Nü-Chuan Chih-Chü Khao 列女傳織具考
Research on the Weaving Implements in the *Lieh NU Chuan.*
TLTC (1972), 45:5, pp. 1-20(235-54).

Tsou Ching-Heng *(2)* 鄒景衡
Shih Chi Chu Sheng Fu 釋機杼滕複
Explaining the Loom, Shuttle, Warp-beam and Cloth-beam.
TLTC (1974), 49:2, PP- '-23-

Tsou Ching-Heng (3) 鄒景衡
Wo-Kuo Tshan-Yeh Pao-Mi Khao 我國蠶業保密考
Research on the Secrecy of Chinese Sericulture.
Chung Kuo Ching Chi Phing Lun 中國經濟評論
(1975).5 . PP-74-

Tsou Ching-Heng *(4)* 鄒景衡
Shih Lung Wa 釋弄瓦
On Playing with the Earthenware Tile.
SHHK 史學彙刊
(1977-8), 9, pp. 211-222.

Tsou Ching-Heng (5) 鄒景衡
Hsiin- Tzu Tshan-Fu Wang I Chi-Fu Chien-Shih 荀子蠶賦王逸機賦箋釋
Commentary on the Silkworm-riddle in Hsün-Tzu and the Loom Rhapsody by Wang I.
TLTC 大陸雜誌
(1978),57:2, pp. 1-8.

Tsou Ching-Heng *(6)* 鄒景衡
Tshai-Sang-Nüyü Kao-Mei 采桑女與高禖
Girls Picking Mulberry-leaves and the God of Matchmaking.
Tsou Ching-Heng (7) *Tshan-Sang Ssu-Chih Tsa-Khao* 蠶桑絲織雜考
Essays on the History of Sericulture and Weaving.
Taipei, 1981, vol. 1, pp. 1-8.

Tsou Ching-Heng (7) 鄒景衡
Tshan-Sang Ssu-Chih Tsa-Khao 蠶桑絲雜考
Essays on the History of Sericulture and Weaving.
San-Min, Taipei, 1981, vol. 1.

Tsou Heng (/) 鄒衡
Shih-Lun Cheng-Chou Hsin-Fa-Hsien ti Yin Shang Wen-Hua I-Chih 試論鄭州新發現的殷商文化遺址
A Preliminary Study of the Material Remains from the Ancient Site of the Yin Period at Cheng-Chou.
KKHP (*i*$_{956}$), 3, pp. 77-103.

Tuan Shih *(2)* 段拭
Kiangsu ' Thung-Shan-Hung-Lou' Tung-Han Mu Chhu- Thu Fang-Chih Hua-Hsiang-Shih 江蘇"銅山洪樓"東漢墓出土紡織畫象石
Stone Reliefs of Looms from Eastern Han Times from Thung-Shan, Hung-Lou in Kiangsu Province.
WW (1962), 3, pp. 31-2.

Tung Tso-Pin *(12)* 董作賓
Hsiao- Thun Ti Erh Pen: Yin-Hsü Wen- Tzu Chia-Pien 小屯第二本：殷虛文字甲編
First Compilation of Shang Characters.
Nanking, 1948; repr., Taipei, 1977.

Tung Tso-Pin (/3) 董作賓
Yin-Hsü Wen-Tzu Wai-Pien 殷虛文字外編
Foreign Compilation of Shang Characters.
Taipei, 1956.

Thung En-Cheng (/) 童恩正
Ku- Tai ti Pa Shu 古代的巴蜀
Szechwan of Ancient Times.
Szechwan Jen-Min, Chheng-Tu, 1979.

Tzunoyama Yukihiro (/) 角山幸洋
Nihon Senshoku Hattatsushi 日本染織発達史
The Historic Development of Textile Arts in Japan.
Tabata Shobö, Tokyo, 1968, 1976.

Wan Chia-Pao (/) 萬家保
Tshung Hsi- Yin- Tshun ti Tshan-Chien Than- Too Chung-Kuo Tsao-Chhi ti Ssu-Chih-Kung-Yeh 從西陰村的蠶繭談到中國早期的絲織工業
From the Cocoon of Hsi-Yin-Tshun to the Silk Industry of Early China.
KKCK (1977), 11:3, PP- 1-17-

Wan Kuo-Ting (6") 萬國鼎
Chhen Fu 'Nung-Shu' Chiao-Chu 陳勇農書校注
A Comparative Annoted Edition of Chhen Fu's *Mung Shu.*
Agriculture Press, Peking, 1965.

Wan Kuo-Ting (//) 萬國鼎

Wan Kuo-Ting (//) *(cont.)*
Nung-Shu Khao-Lüeh 農書攷略
An Account of Investigation into the History of the *JVung-shu.*
Chiang Fu-Tsung (/) 蔣復璁, pp. 68-75.

Wan Kuo-Ting & Mu Chhi-Yu (/) 萬國鼎 & 繆啓愉
Ssu-Min Yüeh-Ling Chi-Shih 四民月令輯釋
Annotated Explanations to the Calendar of the Four Classes.
Nung-Yeh, Peking, 1981.

Wang Chi-Ying & Mou Yung-Khang (/) 汪濟英 &牟永抗
Kuan-Yii Wu-Hsing Chhien-Shan-Tang I-Chih ti Fa-Chueh 關於吳興錢山漾遺址的發掘
Concerning the Excavation of the Chhien-Shan-Yang Site at Wu-Hsing, in Chekiang Province.
AT (1980), 4, pp. 353-8.

Wang Chin & Wujui-Sheng (/) 王勁 & 吳瑞生
Hupei Ching-Shan-Hsien Shih-Lung-Kuo-Chiang Shui-Khu Kung-Chheng Chung Fa-Hsien ti Hsin-Shih-Chhi Shih- Tai I-Chih Chien-Pao 湖北京山縣石龍過江水庫工程中發現的新石器時代遺址簡報
Report on the Excavation of the Neolithic Site Discovered during the Works at Shih-Lung-Kuo-Chiang Water Reservoir in Ching-Shan County, Hupei.
WW(i955),4, pp. 41-6.

Wang Hsiang (/) 王襄
Fu-Shih Tin-Chhi Cheng- Wen 簠室殷契徵文
Tientsin, 1925.

Wangjo-Yii (/) 王若愚
Tshung Thai-Hsi- Tshun Chhu- Thu ti Shang- Tai Chih- Wu ho Fang-Chih Kung-Chü Than Tang-Shih ti Fang-Chih 從台西村出土的商代織物和紡織工具談當時的紡織
Notes on the Shang Dynasty Textile Finds in the Light of the Shang Dynasty Woven Materials and Tools Unearthed from Thai-Hsi-Tshun in Kao-Chheng County, Hopei Province.
WW (1979),6, pp. 49-53.

Wangjo-Yii *(2)* 王若愚
Huang Tao-Pho hsiang Li- Tsu Hsiieh Fang-Chih ti Ku-Shih 黃道婆向黎族學紡織的故事
The Story of how Huang Tao-Pho Learned Spinning and Weaving from the Li People.
MTTC (1961),5, P- 32-

Wangjo-Yii *(3)* 王若愚
Fang-Chih ti Lai-Li 紡織的來歷
Origin of Spinning and Weaving.
Jen Min Hu 人民畫報 (1962), a.

Wangjo-Yii *(4)* 王若愚
Fang-Lunyü Fang-Chuan 紡輪與紡專
Spindle-wheels and Spindle-whorls.
WW (1980),3, pp. 75-7.

Wang Te-I et al. (eds.) (/) 王德毅
Yuan-Jen Chuan-Chi Tzu-Liao So- Tin 元人傳記資料索引
Index to Biographical Materials of Yuan Figures.
Hsin Wen Feng, Taipej, 1979.

Wang Yü-Chung & Phei Chin-Chhang (/) 王裕中 & 裴晋昌
Chung-Kuo Ku- Tai ti Ko Ma Fang-Chih 中國古代的葛麻紡織
The Processing of the Plant Fibres *ko* and *ma* in Ancient China.
In Anon. *{641),* pp. 656-61.

Wang Yü-Hu (/) 王毓瑚
Chung-Kuo Nung-Hsueh Shu-Lu 中國農學書錄
Annotated Bibliography of Chinese Agricultural Works.
Agriculture Press, Peking, 1957, 1964; repr. Taipei, 1981.

Wang Yü-Hu (ed.) *{2)* 王毓瑚
Wang Chen Nung-shu 王禎農書
Nung-Yeh, Peking, 1981.

Wang Yü-Hu (ed.) *(4)* 王毓瑚
JVung-Sang I-Shih Tsho- Tao 農桑衣食撮要
Selected Essentials of Agriculture, Sericulture, Clothing and Food.
Agriculture Press, Peking ist. ed. 1962, 1979.

Watanabe Kanji (/) 渡辺勘次
Kaiko no Kasei ni Kansuru Kenkyí 蚕の化性に関する研究
Studies on the Voltinism of the Silkworm.
SSHK (ic,i8), 1:3:8, pp. 397-437-

Wen I-To *(4)* 聞一多
Wen I- To Chhiian-Chi 聞一多全集
Shanghai, 1948.

Wu Chheng-Lo *(2)* 吳承洛
Chung-Kuo Tu-Liang-Heng Shih 中國度量衡史
History of Chinese Weights and Measures.
Shanghai, 1937.

Wu Ming-Sheng (/) 吳銘生
Chhang-Sha Kuang-Chi-Chhiao Ti- Wu-Hao Chan-Kuo Mu-Kuo-Mu Chhing-Li Chien-Pao 長沙廣濟橋第五號戰國木槨墓清理簡報
Short Report about the Clearing of the Warring State Wood-coffin Tomb no. 5 from Kuang-Chi-Chhiao, Chhang-Sha.
WW (1957), a, pp. 59-63.

Wu Shan (/) 吳山
Shih-Lun Wo-Kuo Huang-Ho Liu-Tii, Chhang-Chiang Liu-Tu ho Hua-Nan Ti-Chhii Hsin-Shih-Chhi Shih- Tai ti Chuang-Shih Thu An 試論我國黃河流域長江流域和華南地區新石器時代的裝飾圖案
Notes on the Decorative Design on Neolithic Ceramics of the Yellow River Valley, the Yangtze, and South China.
WW (1975). 5. PP- 59-72-

Wu Wen-Hsin (/) 吳文信
Wu-Hsien Tshao-Hsieh-Shan I-Chih ti Fa-Chiieh 吳縣草鞋山遺址的發掘
Excavation of the Site of Tshao-Hsieh-Shan, Wu County.
Kuang Ming Jih Pao 光明日報
(1973),6:6, p. 3.

Yabuuchi Kiyoshi (ed.) (//) 薮内清
Tenkö Kaibutsu no Kenkyü 天工開物の研究
Research on The Exploitation of the Works of Nature.
Köseisha, Tokyo, 1953.

Yabuuchi Kiyoshi (ed.) *(26)* 薮内清
Sô Gen Jidai no Kagaku Gijutsu Shi 宋元時代 *CC*科学技術史
A History of Scientific Techniques in the Sung and Yuan Dynasties.
Jimbun Kagaku Kenkyüsho, Kyoto, 1967.

Yabuuchi Kiyoshi (transi.) (27) 薮内清
Tenkö Kaibutsu 天工開物
Translation: The Exploitation of the Works of Nature.
Tokyo, 1969.

Yanagi Söetsu (/) 柳宗悦
Yanagi Söetsu £enshü: 柳宗悦全集*:* 圖錄篇
Complete Works of Yanagi Söetsu: Illustrated Catalogue.
Yanagi Söetsu Bosshü: Mingei Taikan 柳宗悦蒐集 民藝大鑑
Yanagi Söetsu: The Great Mirror of Folk Arts and Crafts.
Chikumashobö, Tokyo, 1981, vol. 3.

Yang Chhi-Chheng (/) 楊啓成
Fukien Tung-Shan-Hsien Kheng-Pei Fa-Hsien Hsin-Shih-Chhi Shih- Tai I-Chih 福建東山縣坑北發現新石器時代遺址
The Neolithic Site Discovered at Kheng-Pei in Tung-Shan County, Fukien.
^(1965). 1, pp. 44-5.

Yang Pai-Hsün (ed.) (/) 楊伯峻
Chhun-Chhiu Tso-Chuan Chu 春秋左傳注
Annotated Edition of the Spring and Autumn Chronicle and Master Tso's Tradition.
Chung-Hua, Peking, 1981.

Yang Tsung-Jung (/) 楊宗榮
Chieh-Shao I-Chien Chhiu Ying She Se Jen- Wu Chiian 介紹一件仇英設色人物卷
Introducing a Coloured Figure Handscroll by Chhiu Ying.
WW (1962), 10, pp. 24-5.

Yao Hsiu (/) 夭秀
I-Fu Sung- Tai Hui-Hua—Fang-Chhe Thu 一幅宋代繪畫—紡車圖
A Handscroll from Sung Times—Picture of a Spindle-wheel.
WW (1961), 2, p. 3, pp. 44, 57.

Yeh Yii-Sen (/) 葉玉森
Yin-Hsü Shu-Chhi Chhien-Pien Chi-Shil 殷虛書契前編集釋
Collected Explanations to Earlier Compilations of Inscriptions on Oracle Bones.
Shanghai, 1934.

Yen Chung-Phing (/) 嚴中平
Ming Chhing Liang- Tai Ti-Fang Kuan Chhang- Too Fang-Chih-Yeh Shih-Li 明清兩代地方官倡導紡織業示例
Examples of the Promotion of Spinning and Weaving Industry by Local Officials in the Ming and Chhing.
TFTC 東方雜誌
(1946), 42:8, pp. 20-6.

Yen Chung-Phing *(2)* 嚴中平
*Chung-Kuo Mien-Fang-Chih Shih-Ka*o 中國棉紡織史稿
History of Cotton Spinning and Weaving in China.
Kho-Hsüeh, Peking, 1955; repr., Peking, 1963.

Yen Phei (/) 延培
Wo-Kuo Ku- Tai Chieh-Chhu ti Fang-Chih-Chia Huanq Tao-Pho 我國古代杰出的紡織家黃道婆
Huang Tao-Pho Our Country's Outstanding Textile Technician of Ancient Times.
Lü Hsing 旅行家 (1958), 3.

Yin Huan-Chang (/) 尹煥章
Nanking So-Chin- Tshun I-Chih Ti-I-Erh- Tzhu Fa-Chiieh Pao-Kao 南京鎖金村遺址第一二次發掘報告
Excavations at So-Chin Village, Nanking.
KKHP (1957), 3, pp. 13-30.

Yin Liang-Ying (/) 尹良瑩
Chung-Kuo Tshan-Ssu-Yeh Fa-Ming yü Chhuan-Po chih Yen-Chiu 中國蠶絲業發明與傳播之研究
Research on the Invention of Sericulture in China and Its Propagation.
TSTK (1976), a, pp. 1-17.

YodaYoshiie (transi.) (/) 依田熹家
*Gen Chuhei, Chûgoku Men Boshoku Shik*o 嚴中平,中国棉紡織史稿
Yen Chung-Phing, A History of Cotton Spinning and Weaving in China.
Tokyo, 1966.

Yonezawa Yoshiho (ed.) (/) 米沢嘉圃
Sekai Bijutsu Taikei. Chûgoku Bijutsu. 世界美術大系 中国美術
Oudine of World Art. Chinese Art.
Kodansha, Tokyo, 1963, 1965, vol. 8.

Yü Hsing-Wu *(2)* 于省吾
Shih Thun 釋屯
Explaining the Character *thun.*
FJHC (1939), 8:2, pp. 85-8

Yuan Thung-Li (/) 袁同禮
(Yung-Lo Ta Tien) Hsien Tshun Chhiian Mu Biao 永樂大典現存卷目表
Census of the Locations and Contents of the still Existing Volumes of the *Yung-Lo Ta Tien* Encyclopaedia.
Q5CÄ/C (1939 (JVS)), 1, p. 246.

Yuan Yü-Ying & Thang Mo-Yao (/) 袁愈荌 & 唐莫堯
Shih-Ching Chhiian-I 詩經全譯
Complete Translation of the Book of Odes.
Kueichou Jen-Min, Kueichou, 1981.

Yüeh Ssu-Ping (/) 樂嗣炳
Chung-Kuo Tshan-Ssu 中國蠶絲
Chinese Sericulture.
Shanghai, 1935.

ADDENDA TO BIBLIOGRAPHY B

Anon. *(766).*
Chih-Ssu Shou- Tshe 制絲手册
Manual of Silk Production.
Chekiang-Sheng Ti-I Chhing-Kung-Yeh-Chü Ssu-Chhou Kung-Ssu 浙江省第一輕工業局絲綢公司
(ed.), Chhing-Kung-Yeh, Peking, 1977.

Anon. (767).
Chih-Ssu-Hsüeh 制絲學
Technology of Silk Production.
Suchou Ssu-Chhou Kung-Hsüeh-Yüan 蘇州絲綢工學院
(ed.), Fang-Chih Kung-Yeh 紡織工業
Peking, 1980.

Anon. (768).
Chu-Ma Tho-Chiao Shih-Ten 苧麻脫膠試驗
Experiments in Degumming Ramie Fibres.
Fang-Chih Kung-Yeh-Pu Sheng-Chhan Chi-Shu Ssu 紡織工業部生產技術司 (ed.),
Fang-Chih Kung-Yeh, Peking, 1958.

Anon. *(76g).*
Fang-Chih Kung- Teh Chi-Shu Tzu-Liao 紡織工業技術資料
Materials on Textile Industry and Technology.
Kho-Hsüeh Wei-Sheng Chhu-Pan-She 科學衛生出版社, Shanghai, 1958.

Anon. *(770).*
Fang-Chih Kung-1-Hsüeh 紡織工藝學
Textile Technology.
Hua-Tung Fang-Chih Kung-Hsüeh-Yüan 華東紡織工學院 (ed.), Fang-Chih Kung-Yeh, Peking, i960.

Anon. *(771).*
Huang-Ma Fang-Chih Shou- Tshe 黃麻紡織手册
Manual on the Spinning and Weaving of Jute.
Chekiang Ma-Fang-Chih-Chhang 浙江麻紡織廠 (ed.), Fang-Chih Kung-Yeh, Peking, 1982.

Anon. *{772).*
Jih—Han Fang-Chih Kung-Teh Tzhu-Hui 日漢紡織工業詞滙
Japanese-Chinese Terms of Textile Industry.
Shanghai-Shih Fang-Chih Kung-Yeh-Chü 上海紡織工業局 (ed.), Fang-Chih Kung-Yeh, Peking, 1983.

Anon. *(773).*
Jih- Ting-Han Ssu-Chhou Chuan- Teh Tzhu-Hui 日英漢絲綢專業詞滙
Japanese—English-Chinese Terms from the Field of Silk Manufacture.
Shanghai-Shih Fang-Chih Kho-Hsüeh Yen-Chiu-Yüan 上海市紡織科學研究院 (ed.), Shanghai, 1977.

Anon. *(774).*
Ma-Fang-Hsiieh 麻紡學
Bast Fibre Spinning Technology.
Hua-Tung Fang-Chih Kung-Hsüeh-Yüan 華東紡織工學院 (ed.), Fang-Chih Kung-Yeh, Peking, i960, 1961, 2 vols.

Anon. *(775).*
Ting-Han Fang-Chih Kung- Teh Tzhu-Hui 英漢紡織工業詞滙. English—Chinese Terms of Textile Industry.
Shanghai-Shih Fang-Chih Kung-Yeh-Chü 上海市紡織工業局 (ed.), Fang-Chih Kung-Yeh, Peking, 1980.

Anon. (776").
Teh-Sheng Chih-Wu Hsien-Wä Po-Chihyü Tho-Chiao 野生植物纖維剝制與脫膠.
The Stripping and Degumming of Fibres from Wild Growing Plants.
Liaoning-Sheng Fang-Chih Kung-Yeh-Chü 遼寧省紡織工業局 (ed.),Jen-Min, Shenyang, i960.

Chang Shan-Neng (ed.) (/) 張善能
Sao-Ssu 繅絲
Silk-reeling.
Fang-Chih Kung-Yeh, Peking, 1959.

Chiang Nai-Yung (ed.) (/) 蔣乃鏞
Ting—Han Fang-Chih-Jan Tzhu- Tien 英華紡織染辭典
English-Chinese Textile Dictionary.
Shih-Chieh Shu-Chü, 1947.

Chiang Nai-Yung (ed.) *(2)* 蔣乃鏞
Ting-Han Fang-Chih-Jan Tzhu- Tien 英漢紡織染辭典
English-Chinese Textile Dictionary.
•95°-

Chiang Nai-Yung (ed.) *(3)* 蔣乃鏞
Fang-Chih-Jan Kung-Chheng Shou- Tshe 紡織染工程手册
Manual of Textile Engineering.
Shanghai Chung-Kuo Wen-Hua Shih-Yeh-She 上海中國文化事業社, Shanghai, 1951.

Chao Chhing-Chhang (/) 趙慶長
Chih-Ssu-Fa 製絲法
Methods of Silk Production.
Chung-Hua Shu-Chü, Shanghai, 1951.

Chu Chi-Hsüan (ed.) (/) 朱積煊
Chu-Ma Tho-Chiao Wen-Thi 苧麻脫膠問題
Problems of Degumming Ramie.
Fang-Chih Kung-Yeh, Peking, 1959.

Fan Shun-Kao (ed.) (/) 范順高
Sao-Ssu 繅絲
Silk-reeling.
Fang-Chih Kung-Yeh, Peking, 1981.

Hsi Te-Heng, Chao Chhing-Chhang (/) 席德衡 趙慶長
Chih-Ssu 制絲
Silk Production.
Fang-Chih Kung-Yeh, Peking, 1982.

LiHsin-Khai (ed.) (/) 李辛凱
Ting-Han Fang-Chih Chuan-Teh Chhang-Tung

Li Hsin-Khai (ed.) (/) *(cont.)*
Tzhu-Hui 英漢紡織專業常用詞滙
English—Chinese Terms in Common Use from the Field of Textile Production.
Shensi Jen-Min, 1974.

Lu Shao-Yün (/) 陸紹雲
Fang-Ckih Jih-Tung Shou- Tske 紡織日用手册
Manual of Daily Use in Textile Production.
Shanghai, (1945).

Sun Hsien-Chih (ed.) (/) 孫先知
Sheng-Ssu Chih-Liang 生絲質量
Qualities of Raw Silk.
Szechwan Kho-Hsüeh Chi-Shu, Chheng-Tu, 1983-

Thao Phing-Shu (ed.) (/) 陶平叔
Jan-Chih Kung-Chheng Ming- Tzhu 染織工程名詞
Terms od Textile Engineering.
Shanghai Chung-Kuo Kung-Chheng Hsüeh-Hui 上海中國工程學會, Shanghai, (1929).

C. BOOKS AND JOURNAL ARTICLES IN WESTERN LANGUAGES

ALLOM, T. & WRIGHT, G.N. (i). *China, in a Series of Views, Displaying the Scenery, Architecture, and Social Habits of that Ancient Empire.* London, 1843.

AMELLI, A. M. (ed.) (1). *Miniature sacra e profane dell'anno 1023 illustranti Venciclopedia medioevale de Rabano Mauro.* Montecassino, 1896.

ANDERSSON, J. G. (3). 'An Early Chinese Culture.' *BGSC,* 1923, 1, 5, 1-68.

ANDREWS, FRED H. (I). 'Ancient Chinese Figured Silks Excavated by Sir Aurel Stein at Ruined Sites of Central Asia.' *BM,* 1920, 37, 3-10, 71-7, 147-52, 215, 265, 326-7.

ANON. (600). *L'art de cultiver des mûriers-blancs, de lever les vers à soye, et de tirer la soye des cocons.* Paris, 1754.

ANON. (601). *Chinese Jute. The Maritime Customs. II. Special Series no. 16.* The Imperial Maritime Customs (ed.). Shanghai, 1891.

ANON. (602). *Dictionnaire archéologique et technique.* Editions de l'accueil. Paris, 1963.

ANON. (603). 'Dissertation on the Silk-manufacture and the Cultivation of the Mulberry; Translated from the Works of Tseu-kwang K'he, Called Paul Siu, a Calao, or Minister of State in China.' *CM,* 1849, **3, 1-108.**

ANON. (604). *Eight Dynasties of Chinese Painting. The Collections of the Nelson Gallery-Atkins Museum, Kansas City, and The Cleveland Museum of Art.* Indiana University Press, Bloomington, Cleveland, 1980.

ANON. (605). *Mélanges en l'honneur de Fernand Braudel: Méthodologie de l'histoire et des sciences humaines.* Toulouse, »973-

ANON. (606). *Textile Terms and Definitions.* The Textile Institute (ed.). 7th ed. Manchester, 1975.

ANON. (607). *South Korea Country and People.* Oxfam Education Department (ed.). Oxford, no year.

ANON. (608). *A Survey of the Silk Industry of Central China.* Shanghai International Testing House (Comp.). Shanghai, 1925.

ANON. (609). *Silk. China. The Maritime Customs. II. Special Series no. 3.* The Imperial Maritime Customs (ed.). Shanghai, 1881.

ARMBRUSTER, GISELA (1). *Das Shigisan Engl Emaki. Ein japanisches Rollbild aus dem 12. Jahrhundert.* Hamburg, 1959. (Mitteilungen der Gesellschaft für Natur- und Völkerkunde Ostasiens (OAG), XL.)

ASHTON, LEIGH (I). 'Chinese Textiles; Kozlôv Discoveries at Noinola and other Pieces.' *RSAJ,* 1936, 84, 3°5-i9-

ASTON, W. G. (tr.) (i). *Nihongi, Chronicles of Japan from the Earliest Times to A.D. 697.* Kegan Paul, London, 1896. (With an Introduction to the New Edition by Terence Barrow.) Tokyo, 1972.

BAINES, PATRICIA (I). *Spinning Wheels, Spinners and Spinning.* Charles Scribner's Sons, New York, 1979.

BALÂSZ, É. (-S.) (7) (tr.). 'Le traité économique du *Souei-Chou [Sui-Shu].'* (Études sur la société et l'économie de la Chine médiévale.) *TP,* 1953, 43, 113. Also sep. issued, Brill, Leiden, 1953.

BALÂSZ, É. (-S.) (8) (tr.). 'Le traité juridique du *Souei-Chou [Sui Shu].' TP,* 1954. Sep. pub. as *Études sur la société et l'économie de la Chine médiévale,* no. a, Brill, Leiden, 1954 (Bibliothèque de l'Inst. des Hautes Études Chinoises, no. 9.)

BALÂSZ, ETIENNE (II). *Chinese Civilization and Bureaucracy.* Ed. with an Introduction by Arthur F.Wright, transi, by H. M. Wright. Yale University Press, New Haven/London, 1964; 2nd pr., 1974.

BALLY, W. (I). 'Abaca.' *CR,* 1953, 99, 3555-9.

BALLY, W. (2). 'Jute and Its Substitutes.' *CR,* 1955, **108,** 3886-909.

BALLY, W. (3). 'Ramie.' *CR,* 1957, **123,** 2-31.

BARNARD, NOEL (ed.) (2). *Early Chinese Art and Its Possible Influence in the Pacific Basin.* (Proceedings of a Symposium Arranged by the Department of Art History and Archaeology, Columbia University, New York City.) Intercultural Arts Press, New York, 1972. Authorised Taiwan ed., 1974.

BARNARD, NOEL (6). *The First Radiocarbon Dates from China.* 2nd ed., Canberra, 1975.

DE BAVIER, ERNEST (I). *La sériciculture et l'industrie de la soie au Japon.* Georg, Lyon, 1874. *Japans Seidenzucht, Seidenhandel und Seiden-Industrie.* Orell, Füssli & Co., Zürich, 1874.

BEASLEY, W. G. & PULLEYBLANK, E. G. (eds.) (1). *Historians of China and Japan.* Oxford Univ. Press, London, 1961.

BECK, TH. (I). *Beiträge zur Geschichte des Maschinenbaues.* Springer, Berlin, 1899-1900.

BERGER, JOSEF (1). *The World's Major Fibre Crops, Their Cultivation and Manuring.* Centre d'Étude de l'Azote, Zürich, 196g.

BINI, TELESFORO (1). 'Su i Lucchesi a Venezia,' *Atti R. Accademia Lucchesi,* 1853, 15.

BIOT, E. (I). *Le Tcheou-li ou Rites des Tcheou.* Imp. Nat., Paris, 1851.

BLEGEN, C.W. & CASKEY, JOHN L. (I). I. *Troy. General Introduction. The First and Second Settlements*

(1950). II. ***Troy. The Third, Fourth and Fifth Settlements*** **(1951). III.** ***Troy. The Sixth Settlement*** **(1953).** IV. *Troy. Settlements Vila, VIIb and VIII* (1958). Princeton University Press, 1950-8. Publ. for the University of Cincinnati.

BLÜMNER, HUGO (I). ***Technologie und Terminologie der Gewerbe und Künste bei Griechen und Römern.*** **Teubner,** Leipzig, 1887; 2nd rev. ed., 1912.

BOCK, F. (1). 'Zoologie und Biologie der Seidenspinner.' In R.O.Herzog and F. Oberlies (eds.) (1). vol. 6: 1, 'Die Seidenspinner', 1-10.

BoDOE, DERK (25). ***Festivals in Classical China. New Tear and Other Annual Observances During the Han Dynasty*** *206 B.C.-A.D. S20.* Princeton University Press, Hong Kong University Press, 1975.

BoDENHEiMER, F. S. (i). *Insects as Human Food.* Haarlem, 1951.

BOHNSACK, ALMUT (I). ***Spinnen und Weben. Entwicklung von Technik und Arbeit im Textilgewerbe.*** **Rowohlt,** Hamburg, 1981. (Deutsches Museum, Kulturgeschichte der Naturwissenschaften und der Technik. Sachbuch rororo, 7702.)

BORN, W. (4). 'Das indische Spinnhandrad und seine Wanderung nach Ost und West.' *CRU,* 1939, 3, 1097-8.

BOSCH, REINHOLD (I). ***Die Steinzeitwerkstätte im Schloss Hallweg.*** **Seengen, 1963-5.**

BOULNOIS, LUCE (1). *The Silk Road.* George Allen & Unwin, London, 1966. Orig. title *La route de la soie.* Paris, •963-

BRANDT, P. (I). ***Schaffende Arbeit und bildende Kunst vom Mittelalter bis zur Gegenwart.*** **Kröner, Leipzig, 1928.** 2 vols.

BRAUDEL, FERNAND (2). ***Civilization and Capitalism I5th-i8th Century.*** **Volume I:** ***The Structures of Everyday Life. The Limits of the Possible*** **(1981). Volume II:** ***The Wheels of Commerce*** **(1982). Volume III:** ***The Perspective*** *of the World* (1984). Collins, London, 1981-4.

BRAY, FRANCESCA (I). *Agriculture,* vol. vi: 2. In Joseph Needham, *Science and Civilisation in China.* Cambridge University Press, Cambridge, 1984.

BRETSCHNEIDER, EMIL (I). *Botanicon Sinicum.* Trübner, London, 1882, vol. 1. *Botanicon Sinicum.* Kelly & Walsh, Shanghai, Hong Kong, 1892, vol. 2. *Botanicon Sinicum.* Kelly & Walsh, Shanghai, Hong Kong, 1895, vol. 3.

BROOK, TIMOTHY (1). 'The Merchant Network in 16th Century China. A Discussion and Translation of Zhang Han's "On Merchants".' *JESHO,* 1981, 2, 34, 165-214.

BUCHANAN, R. A. (1). 'History of Technology in the Teaching of History.' *HT,* 1978, 3, 13-27.

BURCKHARDT, ERWIN (ed.) (i). *Tii-t'i mien-hua-t'u.* Basel, 1974. (Extracts can be found in: *SB,* 1973, «8, 29-40.)

BURKILL, I. H. (1). ***A Dictionary of the Economic Products of the Malay Peninsula.*** **2 vols, published for the Malay** Government by Crown Agents, London, 1935.

BURNHAM, DOROTHY K. (I). *Warp and Weft. A Textile Terminology.* The Hunter Rox Company, Toronto, 1980.

BURNHAM, HAROLD B. (I). *Chinese Velvets. A Technical Study.* Toronto, 1959. (Royal Ontario Museum, Art and Archaeology Division, Occasional Paper, 2.)

BURNHAM, HAROLD B. (2). 'Une armure gaze complexe chinoise.' *BL,* 1959, 9, 29-35.

BURNHAM, HAROLD B. (3). 'Catal Hüyük—The Textiles and Twine Fabrics.' *AS,* 1965, 15, 169-74.

BURNHAM, HAROLD B. (4). 'Technical Aspects of the Warp-faced Compound Tabbies of the Han Dynasty.' *BL,* 1965, aa, 25-45.

BURNHAM, HAROLD B. (5). 'La préparation des fils de soie en Chine ancienne.' *BL,* 1968, *vj,* 54-8.

CAHILL, JAMES (I). ***An Index of Early Chinese Painters and Paintings. T'ang, Sung, and Titan, Incorporating the*** *Work of Osvald Siren and Ellen Johnston Laing.* University of California Press, Berkeley, 1980.

CALLIAND, F. (1). ***Recherches sur les arts et métiers.*** **Paris, 1831.**

CARTER, THOMAS FRANCIS & GOODRICH, L. CARRINGTON (1). *The Invention of Printing and Its Spread Westward.* New York: The Ronald Press Company, 1955, second edition.

CARUS-WILSON, E. M. (2). 'The Woollen Industry (in the Middle Ages).' In M. Postan and E. E. Rich **(eds.) (1).** ***Cambridge Economic History of Europe.*** **Cambridge, 1952, vol. 2.**

CASTELLINI, LUIGI (I). 'Hemp.' *CR,* 1962, 5, 2-31.

CATON-THOMPSON, D. & GARDNER, E. W. (I). *The Desert Fayum.* Royal Anthropological Institute, London, 1934-

CENTRE INTERNATIONAL D'ÉTUDE DES TEXTILES ANCIENS (ed.) (1). *Vocabulary of Technical Terms.* Lyon, 1964.

CHAMBERS, E. & REES, A. (1). ***Cyclopaedia; or Universal Dictionary of Arts and Sciences.*** **London, 1728. 8th ed.,** London, 1788.

CHANG, K. C. (I). *The Archaeology of Ancient China.* 3rd rev. ed., Yale University Press, New Haven, 1977.

CHANG, K. C. (2). ***Fengpitou, Tapenkeng and the Prehistory of Taiwan.*** **New Haven, Conn., 1969. (Yale** University Publications in Anthropology, 73.)

CHANG, K. C. (6). ***Early Chinese Civilization. Anthropological Perspective.*** **Cambridge, Mass., 1976. (Harvard-**Yenching Institute Monograph Series, 23.)

CHAO KANG (I). ***The Development of Cotton Textile Production in China.*** **Cambridge, Mass., 1977. (Harvard** East Asian Monographs, 74.)

CHAO KANG (2). 'The History of Cotton Planting in China.' *Touth Monthly,* Nov. 1975, »75, 31-41.

CHARLESTON, R.J. (1). 'Han Damasks.' *OA,* 1948, 2, 1, 63-81.

CHATLEY, H. (I). MS. translation of the astronomical chapter (Ch. 3, Thien Wen) of *Huai Nan Tai.* Unpublished.

CHAVANNES, É. (1). ***Les Mémoires Historiques de Se-Ma Ts'ien [Ssu-tna Chhien].*** **5 vols. Leroux, Paris, 1895-1905.** (Photographically reproduced in China, without imprint and undated.)

1895 vol. 1 tr. *Shih Chi,* chs. 1, 2, 3, 4.
1897 vol. 2 tr. *Shih Chi,* chs. 5, 6, 7, 8, 9, 10, 11, 12.
1898 vol. 3 (i) tr. *Shih Chi,* chs. 13, 14, 15, 16, 17, 18, 19, 20, 21, 22.
vol. 3 (ii) tr. *Shih Chi,* chs. 23, 24, 25, 26, 27, 28, 29, 30.
1901 vol. 4. tr. *Shih Chi,* chs. 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42.
1905 vol. 5 tr. *Shih Chi,* chs. 43, 44, 45, 46, 47.

CHAVANNES, E. (6) (tr.). 'Les Pays d'Occident d'après le Heou Han Chou.' *TP,* 1907,8, 149. (Ch. 118, on the Western Countries, from *Hou Han Shu.)*

CHAVANNES, É. (16). 'Trois Généraux Chinois de la Dynastie des Han Orientaux.' *TP,* 1906, 7, 210. (Tr. ch. 77 of the *Hou Han Shu* on Pan Chhao, Pan Yung and Liang Chhin.)

CHENG TE-KHUN (17). ***Archaeology in China,*** **Vol.** ***1 : Prehistoric China. Keffers,*** **Cambridge, 1959. (18)** ***Archaeology in China,*** **Vol. 2:** ***Shang China.*** **Heffers, Cambridge, i960. (19)** ***Archaeology in China,*** **Vol. 3:** ***Chou*** *China.* Heffers, Cambridge, 1963. (16) *Archaeology in China,* Supplement to Volume 1 : *New Light on Prehistoric China.* Heffers, Cambridge, 1966.

CHENG TE-KHUN (20). 'The Prehistory of China.' *TP,* 1974, LX, 1-3, 1-11.

CHHÜ THUNG-TSU (2). *Han Social Structure.* University of Washington Press, Seattle, London, 1972. (Han Dynasty China, vol. 1.)

CIPOLLA, CARLO M. (éd.) (4). ***The Fontana Economie History of Europe.*** **Vol. 1,** ***The Middle Ages.*** **London, 1972.** 6th impr., Glasgow, 1981.

CLARK, G. (4). *World Prehistory in New Perspective.* 3rd rev. ed. Cambridge, 1977.

CLARK, G. & PIGOOTT, S. (1). *Prehistoric Societies.* Harmondsworth, 1965; repr., 1976.

CONSTEN, E. VON ERDBERG (I). 'A "hu" with Pictorial Decoration, Werner Jannings Collection; Palace **Museum, Peking.'** ***Archives of the Chinese Art Society of America,*** **1952, vi, 18-32 ill.**

COUVREUR, F. S. (1). *Tch'ouen Ts'iouet Tso Tchouan.* Hokienfu, 1914.

Tch'ouen Ts'iou et Tso Tchouan. La Chronique de la Principauté de Làu. **Paris, Leiden, 1951.**

COUVREUR, F. S. (3). ***Li-Ki ou Mémoires sur les Bienséances et les Cérémonies.*** **Hochienfu, 1913.**

CREEL, H. G. (4). *Confucius; the Man and the Myth.* Day, New York, 1949/Kegan Paul, London, 1951. Review D. Bodde, *JAOS,* 1950, 70, 199.

CROISSANT, DORIS (I). 'Funktion und Wanddekor der Opferschreine von Wu Liang tz'u. Typologische und ikonographische Untersuchungen.' *MS,* 1964, 23, 88-162.

CROWFOOT, GRACE M. (1). 'Textiles, Basketry and Mats.' In Charles Singer, E.J. Holmyard and A. R. Hall (eds.) (1). *A History of Technology.* Oxford, 1954, vol. 1, 413-51.

CROWFOOT, GRACE M. (2). ***Methods of Handspinning in Egypt and the Sudan.*** **(1931.)**

DAVIES, NORMAN DE GARIS (I). *Five Theban Tombs.* London, 1913.

DAVIES, NORMAN DE GARIS (2). *The Town House in Ancient Egypt.* London, 1929.

DAY, FLORENCE E. (I). 'Silks of the Near East.' *MM AB,* 1950, 108 ff.

DELAPORTE, YVES (I). *Les vitraux de la cathédrale de Chartres.* Houvet, Chartres, 1926.

DELAPORTE, YVES (2). ***L'art du vitrail aux XII[e] et XIII[e] siècles. Technique—inspiration.*** **Houvet, Chartres, 1978.**

DENHÖFER, W. (I). *Das illustrierte Seilerbuch.* Leipzig, 1869.

DERRY, T. K. & WILLIAMS, TREVOR I. (1). ***A Short History of Technology. From the Earliest Times to A.D. 1000.*** Oxford University Press, Oxford, 1970; 4th impr., 1976.

DIBNER, B. (ed.) (2). ***The 'New Discoveries' (Nova Reperta); the Sciences, Inventions and Discoveries of the Middle Ages and the Renaissance as Represented in 24 Engravings Issued in the Early 1580s by Stradanus.*** **Burndy** Library, Norwalk, Conn., 1953.

DIDEROT, DENIS & D'ALEMBERT, JEAN LE ROND (I). ***Encyclopédie ou dictionnaire raisonné des sciences, des arts et des métiers.*** **Paris, 1751-77.** ***Recueil de planches sur les sciences, les arts libéraux et les arts mécaniques avec leur explication.*** **Paris, 1763-77. (Repr. of the plates in 4 vols. :** ***Diderot Encyclopedia. The Complete Illustrations*** *1762-1777.* Abrams, New York, 1978.)

DIETRICH, CRAIG (I). ***Cotton Manufacture and Trade in China (c. 1500-1800).*** **(Ph.D. thesis, University of** Chicago, 1970.)

DIETRICH, CRAIG (2). 'Cotton Culture and Manufacture in Early Ch'ing China.' In W. E. Willmott **(ed.) (1).** ***Economic Organization in Chinese Society.*** **Stanford, 1972, 109-35.**

DOUGLAS, R. K. (I). *Orientalia Antiqua.* 1882.

DREW, KATHERINE F. & LEAR, FLOYD S. (eds.) (1). *Perspectives in Medieval History.* Chicago, 1963.

DUBS, HOMER H. (7). *The Works of Hsäntze.* London, 1928. (Probsthain's Oriental Series, XVI.)

DUYVENDAK, J. L. L. (tr.) (3). ***The Book of the Lord Shang; a Classic of the Chinese School of Law.*** **Probsthain,** London, 1928.

EBERHARD, W. (I). ***Kultur und Siedlung der Randvölker Chinas.*** **Brill, Leiden, 1942.** ***(T'oung Pao*** **Suppl.)**

EBERHARD, W. (9). ***A History of China from the Earliest Times to the Present Day.*** **Routledge & Kegan Paul,** London, 1950.

EBERHARD, W., MÜLLER, R. & HENSELING, R. (I). 'Beiträge z. Astronomie d. Han-Zeit. II.' *SPAWjPH,* '933. »3> 937-

EBERT, JORINDE & KAULBACH, BARBARA M. (I). *Religiöse Malerei aus Taiwan.* Joh. Aug. Koch, Marburg, 1980-

EBREY, PATRICIA BUCKLEY (ed.) (3). *Chinese Civilization and Society. A Sourcebook.* The Free Press, New York, 1981.

EHRENREICH, PAUL (I). ***Beiträge zur Völkerkunde Brasiliens.*** **Berlin, 1891.**

EICHHORN, WERNER (5). 'Wang Chia's Shih-i-chi.' *ZDMG,* 1952, **10a,** 130-42.

EICHHORN, WERNER (14). 'Zur Vorgeschichte des Aufstandes von Wang Hsiao-po und Li Shun in Szuchuan (993-995).' *ZDMG,* 1955, 1, **105,** 192-209.

EICHHORN, WERNER (15). *Die Religionen Chinas.* Kohlhammer, Stuttgart, Berlin, 1973.

ELVIN, MARK (2). *The Pattern of the Chinese Past.* Stanford University Press/Methuen, London, 1972.

EL VIN, MARK (tr.) (4). Shiba Yoshinobu, *Commerce and Society in Sung China.* Ann Arbor, 1970. (Michigan Abstracts of Chinese and Japanese Works on Chinese History, 2.)

ELVIN, MARK (5). 'The High-level Equilibrium Trap: The Causes of the Decline of Invention in the Traditional Chinese Textile Industries.' In W. E. Willmott (ed.) (1). *Economic Organization in Chinese Society.* Stanford, 1972, 137-72.

EMERY, IRENE (I). *The Primary Structures of Fabrics.* The Spiral Press, Washington, D.C., 1966.

Encyclopaedia Britannica. **(13th ed., 1926).**

ENDREI, WALTER (1). ***L'évolution des techniques du filage et du tissage du moyen âge à la révolution industrielle.*** La Haye, Paris, 1968.

ENDREI, WALTER (2). 'La transformation de la soie, vue à travers une série d'esquisses du XVI[e] siècle.' **In Anon. (605),** ***Mélanges en l'honneur de Fernand Braudel: Méthodologie de l'histoire et des sciences humaines.*** Toulouse, 1973, 207-20.

ENDREI, W. & STROMER, W. V. (I). 'Textiltechnische und hydraulische Erfindungen und ihre Innovatoren in Mitteleuropa im 14./15. Jahrhundert.' *TG,* 1974, 41, 89-117.

ENG, ROBERT Y. (I). 'Silk Reeling Enterprises in Canton and Shanghai.' *Paper for the Conference on the* ***Colonial Port City in Asia.*** **(June, 1976).**

ENG, ROBERT Y. (2). ***Imperialism and Chinese Economy: The Canton and Shanghai Silk Industry 1861-1932.*** (Ph.D. thesis, University of California, Berkeley, 1978.)

ENGLERT, SIEGFRIED (I). ***Materialien zur Stellung der Frau und zur Sexualität im vormodernen und modernen China.*** Haag and Herchen, Frankfurt am Main, 1980. (Heidelberger Schriften zur Ostasienkunde, 1).

ENGLISH, W. (I). 'The Textile Industry: Silk Production and Manufacture, 1750-1900.' Charles Singer *et al.* (eds.) (1). *A History of Technology.* Oxford, 1958, vol. 4, 308-27.

ENGLISH, W. (2). ***The Textile Industry: An Account of the Early Inventions of Spinning, Weaving and Knitting Machines.*** Longmans, London, 1969.

ENGLISH, W. (3). 'Early Circular Throwing Machines.' *TH,* 1971, 1, a, 65-75.

ERKES, E. (tr.) (1). 'Das Weltbild d. *Huai-nan-tze*' (tr. of ch. 4). 0£, 1918, 5, 27.

ERMAN, ADOLF (I). *Life in Ancient Egypt.* London, 1894.

ERMAN, ADOLF & GRAPOW, HERMANN (I). *Wörterbuch der ägyptischen Sprache.* Berlin, 1926-51 ; 2. Neudruck, Berlin, 1957; (die Belegstellen, Berlin, 1958, 2. Neudruck).

ESSENWEIN, A. VON (ed.) (1). ***Das Mittelalterliche Hausbuch. Bilderhandschrift des /5. Jahrhunderts.*** **Keller,** Frankfurt, 1887; Leipzig, 1912; München, 1957.

FALKE, OTTO VON (I). *Kunstgeschichte der Seidenweberei.* Wasmuth, Berlin, 1913.

FALKE, OTTO VON (2). *Decorative Silks.* Wasmuth, Berlin; Batsford, London, 1922.

FANNIN, ALLEN (1). *Handspinning: Art and Technique.* Von Nostrand Reinhold, New York, 1970.

FAUVEL, A. (I). *Les séricigènes sauvages de la Chine.* Ernest Leroux, Paris, 1895.

FEI HSIAO-TUNG (3). *Chinese Village Close-up.* New World Press, Peking, 1983.

FELDHAUS, FRANZ MARIA (I). ***Die Technik. Ein Lexikon der Vorzeit, der geschichtlichen Zeit und der Naturvölker.*** Engelmann, Leipzig, 1, Aufl., 1914; repr., München, 1970.

FELDHAUS, FRANZ MARIA (2). *Die Technik der Antike und des Mittelalters.* Athenaion, Potsdam, 1931.

FERGUSON, JOHN (I). 'China and Rome.' In *Hildegard Temporini* (ed.) (1). *Aufstieg und Niedergang der* ***Römischen Welt. Geschichte und Kultur Roms im Spiegel der Neueren Forschung.*** **De Gruyter, Berlin, 1978,** vol. 9: 2, 581-603.

FESKA, M. (I). ***Beiträge zur Kenntnis der japanischen Landwirtschaft.*** **Tokyo. 1889-93.**

FINSCH, OTTO (I). ***Ethnologische Erfahrungen und Belegstücke aus der Südsee.*** **Wien, 1893.**

FINSCH, OTTO (2). *Südseearbeiten.* Hamburg, 1914.

FINSTERBUSCH, KÄTHE (2). ***Verzeichnis und Motivindex der Han-Darstellungen. VoX.*** **1, Harrassowitz, Wiesbaden,** 1966; vol. 2, Harrassowitz, Wiesbaden, 1971.

FISKE, PATRICIA L. (ed.) (1). *Archaeological Textiles.* Washington, D.C., 1974.

FONTEIN, JAN & Wu TUNG (I). ***Han and T'ang Murals Discovered in Tombs in the People's Republic 0/China and Copied by Contemporary Chinese Painters.*** **Boston, 1976.**

FORBES, R.J. (2). ***Man the Maker. A History of Technology and Engineering.*** **Schuman, New York, 1950.**

FORBES, R.J. (13). *Studies in Ancient Technology.* Brill, Leiden, 1956, vol. 4.

FORKE, A. (tr.) (3). ***Me Ti. Des Sozialethikers und seiner Schüler philosophische Werke.*** **Berlin, 1922.** ***(MSOS,*** Beiband, 23 to 25.)

FORKE, ALFRED (13). *Geschichte der alten chinesischen Philosophie.* De Gruyter, Hamburg, 1927; repr., Hamburg, 1964. (Abhandlungen aus dem Gebiet der Auslandskunde Bd. 25—Reihe B. Völkerkunde, Kulturgeschichte und Sprachen, Bd. 14.)

FRANKE, GÜNTHER (I). ***Nutzpflanzen der Tropen und Subtropen.*** **Band II.** ***Obstliefernde Pflanzen, Zuckerliefernde Pflanzen, Getreide, Faserpflanzen.*** **S. Hirzel, Leipzig, 1967.**

FRANKE, HERBERT (ed.) (19). *Sung Biographies.* Franz Steiner, Wiesbaden, 1976. (Münchener Ostasiatische Studien, 16.)

FRANKE, HERBERT & TRAUZETTEL, ROLF (I). *Das Chinesische Kaiserreich.* Frankfurt, 1968. (Fischer Weltgeschichte, 19.)

FRANKE, OTTO (II). ***Keng Tschi T'u. Ackerbau und Seidengewinnung in China. Ein kaiserliches Lehr- und Mahnbuch.*** Friederichsen, Hamburg, 1913. (Abhandlungen des Hamburgischen Kolonialinstitutes, 11.)

FRANKE, OTTO (14). 'Zur Geschichte des Keng-chih-t'u. Ein Beitrag zur chinesischen Kunstgeschichte und Kunstkritik.' *OZ,* 1914-15, 3, 169-208.

FRANKE, WOLFGANG & STAIGER, BRÜNHILD (eds.) (1). *China-Handbuch.* Bertelsmann, Düsseldorf, 1974.

FRANKEL, H. H. (I). ***Catalogue of Translations from the Chinese Dynastic Histories for the Period + 220 to +g6o.*** University of California Press, Berkeley and Los Angeles, 1957. (Institute of International Studies, University of California, East Asia Studies, Chinese Dynastic Histories Translations, Supplement no. 1.)

FRASER, E. D. H. & LOCKHART, J. H. S. (1). *Index to the Tso chuan.* Oxford, 1930.

FRÖDIN, OTTO & NORDENSKIÖLD, ERLAND (I). ***Über Zwirnen und Spinnen bei den Indianern Südamerikas.*** Göteborg, 1918.

FUCHS, WALTER (8). 'Zum Keng-chih-t'u der Mandju-Zeit und die Japanische Ausgabe von 1808.' **In I. L. Kluge (ed.) (1).** ***Ostasiatische Studien. Martin Ramming zum 70. Geburtstag gewidmet.*** **Akademie-Verlag,** Berlin, 1959, 67-80

FUCHS, WALTER (9). ***Chinesische und mandjurische Handschriften und seltene Drucke.*** **Franz Steiner, Weisbaden,** 1966. (Verzeichnis der Orientalischen Handschriften in Deutschland, XII. 1.)

FURTNER, MICHAEL, *see* RITTER VOM TURN.

GALE, ESSON M. (1). ***Discourses on Salt and Iron. A Debate of Commerce and Industry in Ancient China, Chapters 1-19.*** Brill, Leiden, 1931. (Sinica Leidensia Edidit Institutum Sinologicum Lugduno-Batavum, II; repr., Taipei, 1973.)

GEISBERG, MAX (1). *The German Single-leaf Woodcut: 1500-1550.* Rev. and ed. by Walter L. Strauss. Hacker, New York, 1974. vol. 1.

GERNET, JACQUES (2). ***Daily Life in China on the Eve of the Mongol Invasion, 1250-1276.*** **Stanford University** Press, Stanford, 1962; paperback, 1970. (Translated from the French by H. M. Wright, originally **published as** ***La vie quotidienne en Chine à la veille de l'invasion mongole, 1250-1276.*** **Hachette, Paris, 1959.**

GERNET, JACQUES (4). ***Die Chinesische Welt. Die Geschichte Chinas von den Anfängen bis zur Jetztzeit.*** **Insel,** Frankfurt am Main, 1979; 3rd ed., 1983. (Translated from the French by Regine Kappeier, originally published (3) as *Le Monde chinois.* Armand Colin, Paris, 1972; Engl. ed. (5), *A History of Chinese Civilization.* Cambridge University Press, Cambridge, 1982).

GERVERS, VERONIKA (ed.) (1). *Studies in Textile History.* Royal Ontario Museum, Toronto, 1977.

GHIRSHMAN, R. (I). *Fouilles de Sialk, près de Kashan 1933, 1934, 1937.* Paris, 1938-9, vols. 1, 2. (Musée du Louvre, Department des Antiquités Orientales Série Archéologique, IV.)

GILES, HERBERT A. (1). *A Chinese Biographical Dictionary.* Kelly & Walsh, London, Shanghai, 1898; repr. Taipei, 1972.

GILES, HERBERT A. (2). *A Chinese-English Dictionary,* ist ed., Shanghai/London, 1892; 2nd ed., Shanghai/London, 1912; repr., Taipei, 1972.

GILES, L. (2). ***An Alphabetical Index to the Chinese Encyclopaedia (Chhin Ting Ku Chin Thu Shu Chi Chheng).*** British Museum, London, 1911.

GOEPPER, R., KUHN, D. & WIESNER, U. (eds.) (1). ***Z"r Kunstgeschichte Asiens, 50 Jahre Lehre und Forschung an der Universität Köln.*** Franz Steiner, Wiesbaden, 1977. (Publikationen der Abteilung Asien. Kunsthistorisches Institut der Universität Köln, 1.)

GÖTZE, A. (I). 'Spinnen mit Spindel und Wirtel.' ££, 1896, 5, 38, 473.

GOODRICH, L. CARRINGTON (3). 'Cotton in China.' *Isis,* 1942-3, 34, 408-10.
GOODRICH, L. CARRINGTON & CAMERON, NIGEL (I). *The Face of China as Seen by Photographers and Travellers 1860-1912.* Aperture Inc., New York, 1978.
GOODRICH, L. CARRINGTON & CHAOYINGFANG (eds.) (1). *Dictionary of Ming Biography 1368-1644. {The Ming Biographical History Project of the Association for Asian Studies.)* Columbia University Press, New York, 1976.
GORMAN, C. F. (4). 'Hoabinhian: A Pebble-tool Complex with Early Plant Associations in Southeast Asia.' *Science* CLXIII, 3868, 14 February 1969, 671-3.
GRISELINI, FR. (I). *II setificio ovvero memorie dodici.* Verona, 1783.
VAN GULIK, ROBERT (8). *Sexual Life in Ancient China. A Preliminary Survey of Chinese Sex and Society from c. 1500 B.C. till 1644 A.D.* Brill, Leiden, 1961.
VAN GULIK, ROBERT (9). *The Chinese Maze Murders.* The Hague, 1957.
GUTMANN, A. L. (1). 'Cloth-making in Flanders.' *CR,* 1938, 2, 14, 466.
HALD, M. (I). 'The Nettle as a Culture Plant.' *FL,* 1942, 6, 28-49.
DU HALDE, J. B. (1). *Description de l'empire de la Chine et de la Tartane chinoise.* Paris, 1735, 1739. *{Ausführliche Beschreibung des chinesischen Reichs und der grossen Tartarey.* Rostock, 1747-9.)
DU HALDE, J. B. (2). (Introduction by Mario Bussagli). *Seide und Baumwolle im Mandschu-China.* Weber, Genf, 1980.
HALOUN, G. (2). 'Translations of *Kuan Tzu* and other ancient texts made with Joseph Needham.' Unpub. MSS.
HALOUN, G. (5). 'Legalist Fragments, I: *Kuan Tzu* ch. 55, and related texts.' *AM,* 1951 (n.s.), a, 85.
D'HARCOURT, RAOUL (I). *Textiles of Ancient Peru and their Techniques.* Ed. by Grace G. Denny & Carolyn M. Osborne. University of Washington Press, Seattle, 1962.
HAUSER, FRIEDRICH (I). 'Aristophanes und Vasenbilder.' *JÖAI,* 1909, is, 83, figs. 50 and 51.
HAWKES, JACQUETTA & WOOLLEY, SIR LEONARD (I). *Prehistory and the Beginnings of Civilization.* Allen & Unwin, London, 1963. (History of Mankind, vol. 1.)
HEDDE, ISIDORE (2). *Description méthodique de l'industrie sérigène de la Chine.* Saint-Étienne, 1848.
HEEREN-DIEKHOFF, ELFIE (I). *Das Hsi-ching tsa-chi. Vermischte Aufzeichnungen über die westliche Hauptstadt.* Weilheim/Obb., 1981.
HEICHELHEIM, F. M. (I). 'Silk Trade and Silk Industry in Byzantium.' *CR,* 1949, 75, 2753-9.
HEICHELHEIM, F. M. (2). 'Byzantine Silk Fabrics.' *CR,* 1949, 75, 2761-7.
HELBAEK, H. (I). 'Textiles from Catal Hüyük.' *A,* 1963, 16, 39-46.
HENNIG, R. (I). 'Die Einführung der Seidenraupenzucht ins Byzantinerreich.' *BZ,* 1933, 33, 295-312.
HENTSCHEL, KURT (I). *Wolle spinnen mit Herz und Hand.* W. Metzner, Frankfurt am Main, 1949; repr. Winterbach-Manolzweiler, 1975.
HERMANT, P. (I). 'Flax Cultivation.' *CR,* 1965, a, 10-17.
HERRMANN, A. (2). *Die alten Seidenstrassen zwischen China und Syrien.* Berlin, 1910. (Quellen u. Forschungen z. alten Gesch. u. Geographie, no. 21; photographically reproduced, Tientsin, 1941.)
HERRMANN, A. (6). *Die Verkehrswege zwischen China, Indien und Rom um 100 n. Chr. Geburt.* Leipzig, 1922. (Veröffenflichungen d. Forschungsinstitutes f. vergleichende Religionsgeschichte a.d. Universität Leipzig, no. 7.)
D'HERVEY ST DENYS, M. J. L. (tr.) (1). *Ethnographie des Peuples Étrangers à la Chine; ouvrage composé au 13^e^ siècle de notre ère par Ma Touan-Lin. . .avec un commentaire perpétuel.* Georg & Mueller, Geneva, 1876-83, 4 vols. (Translation of chs. 324-48 of the *Wen Hsien Thing Khao* of Ma Tuan-Lin.) Vol. 1, Eastern Peoples; Korea, Japan, Kamchatka, Taiwan, Pacific Islands (chs. 324-7). Vol. 2. Southern Peoples; Hainan, Tongking, Siam, Cambodia, Burma, Sumatra, Borneo, Philippines, Moluccas, New Guinea (chs. 328-32). Vol. 3. Western Peoples (chs. 333-9). Vol. 4. Northern Peoples (chs. 340-8).
HERVOUET, YVES (ed.) (2). *A Sung Bibliography {Bibliographie des Sung).* The Chinese University Press, Hong Kong, 1978.
HERZOG, R. O. & OBERLIES, F. (eds.) (1). *Technologie der Textilfasem.* Julius Springer, Berlin, 1938, vol. 6.
HINDER, ELEANOR M. (1). *Life and Labour in Shanghai: A Decade of Labour and Social Administration in the International Settlement.* Institute of Pacific Relations, New York, 1944.
HIRTH, F. (tr.) (2). 'The Story of Chang Chhien, China's Pioneer in West Asia.' *JAOS,* 1917, 37, 89. (Translation of ch. 123 of the *Shih Chi,* containing Chang Chhien's Report; from §18-52 inclusive and 101 to 103. §98 runs on to § 104, 99 and 100 being a separate interpolation. Also tr. of ch. ? containing the biography of Chang Chhien.)
Ho PING-TI (4). *Studies on the Population of China, 1368-1953.* Harvard University Press, Cambridge, Mass., 1959. (Harvard East Asian Studies, 4.)
Ho PING-TI (5). *The Cradle of the East: an Inquiry into the Indigenous Origins of Techniques and Ideas of Neolithic and Early Historic China, 5000-1000 B.C.* The Chinese University of Hong Kong/The University of Chicago Press, Hong Kong/Chicago, 1975.

HODGES, HENRY (I). *Artifacts. An Introduction to Early Materials and Technology.* Humanities Press, New Jersey; John Baker, London, 1964; repr. 1981.
HOMMEL, RUDOLPH P. (1). *China at Work, an Illustrated Record of the Primitive Industries of China's Masses, whose Life is Toil, and thus an Account of Chinese Civilization.* The John Day Comp., New York, 1937; repr. MIT Press, Cambridge, Mass., 1969.
HOOK, BRIAN (ed.) (1). *The Cambridge Encyclopedia of China.* Cambridge University Press, Cambridge, 1982.
HOOPER, L. (I). 'The Loom and Spindle: Past, Present, and Future.' *SI AR 1914,* 1915, 629-79.
HoRwiTZ, H. T. (5). ' Die Drehbewegung in ihrer Bedeutung für die Entwicklung der materiellen Kultur.' *APS,* 1933, a8, 721-57; 1934, 29, 99-125.
HoRWiTz, H. T. (13). 'Zur Geschichte des Spinnrades.' *GTIG,* 1915, 11, 55.
HORWITZ, H. T. (14). 'Drehbewegung und Spinnen.' *CRU,* 1941, 49, 1782-1808.
HOWARD, CHARLES WALTER & BUSWELL, KARL P. (1). *A Survey of the Silk Industry of South China.* Commercial Press, Hong Kong, 1925.
Hsü CHO-YÜN (3). *Ancient China in Transition. An Analysis of Social Mobility 722-222 B.C.* Stanford University Press, Stanford, 1977.
Hsü CHUNG-SHU (I). "The Well-field System in Shang and Chou.' E-tu Zen Sun & John de Francis (eds. and tr.) (1). *Chinese Social History. Translations of Selected Studies.* (1956), 18-20.
HUGHES, E. R. (tr.) (1). *Chinese Philosophy in Classical Times.* Dent, London, 1942. (Everyman Library, no. 973.)
HUMMEL, ARTHUR W. (ed.) (2). *Eminent Chinese of the Ch'ing Period.* Library of Congress, Washington D.C., 1944; repr. Taipei, :972.
HUMMEL, ARTHUR W. (23). 'Pictures on Tilling and Weaving.' *ARLC,* 1928-9, 217-21 ; 1938, 285-8.
HUNDT, HANS-JÜRGEN (I). ' Die Textilreste aus dem Hohmichele.' In Gustav Riek (ed.) (1). *Der Hohmichele. Ein Fürstengrabhügel der Späten Hallstattzeit bei der Heuneburg.* Berlin, 1962, 199-214.
HUNDT, HANS-JÜRGEN (2). 'Über vorgeschichtliche Seidenfunde.' *JRGZM,* 1969, 16, 59-71.
HUTCHINSON, J. B. (2). *Evolutionary Studies on World Crops: Diversity and Change in the Indian Subcontinent.* Cambridge University Press, Cambridge, 1974.
HUTCHINSON, J. B., SILOW, R. A. & STEPHENS, S. C. (I). *The Evolution of Gossypium.* Oxford University Press, London, 1947.
HUTTON, J. H. (1). *The Sema Nagas.* London, 1921.
JACKSON, B. D. (I). *Index Kewensis. Enumeration of the Genera and Species of Flowering Plants.* Clarendon Press, Oxford, 1893- .
JIRLOW, R. (I). *Sländspinning i sverige.* Stockholm, 1931. (Svenska kulturbilder, 5.)
JOYCE, C. R. B. & CURRY, S. H. (eds.) (1). *The Botany and Chemistry of Cannabis.* London, 1970.
JULIEN, STANISLAS (2). *Mélanges de géographie asiatique et de philologie sinico-indienne.* Paris, 1864.
JULIEN, STANISLAS (12). *Résumé des principaux traités chinois sur la culture des mûriers et l'éducation des vers à soie.* Imprimerie Royale, Paris, 1837.
KAPLAN, EDWARD H. (tr.) (1). *An Economie History of China by Chou Chin-sheng. A Translation in Précis.* Bellingham, Washington, 1974. (Western Washington State College. Program in East Asian Studies. Occasional Paper, 7.)
KARLGREN, BERNHARD (I). *Grammata Serica Recensa.* Stockholm, 1972. (Reprinted from *BMFEA,* 1957, ag.)
KARLGREN, BERNHARD (8). 'The Authenticity and Nature of the Tso Chuan.' *GHA,* 1926, 3, 3a, 64-5.
KARLGREN, BERNHARD (14). *The Book of Odes.* Stockholm, 1974. (Reprinted from *BMFEA,* 1944, 16; '945. «70
KARLGREN, BERNHARD (12) (tr.). *The Book of Documents.* Stockholm, 1950. (Published in the *BMFEA,* 1950, aa, 1-81.)
KEIGHTLEY, DAVID N. (2). *Sources of Shang History. The Oracle-bone Inscriptions of Bronze Age China.* University of California Press, Berkeley, 1978.
KEIGHTLEY, DAVID N. (3). *Public Work in Ancient China: A Study of Forced Labour in the Shang and Western Chou.* (Ph.D. thesis, Columbia University, 1969; University Microfilms, no. 72-15, 577.)
KEIGHTLEY, DAVID N. (ed.) (4). *The Origins of Chinese Civilization.* University of California Press, Berkeley, 1983. (Studies on China, 1.)
KELLER, A. G. (I). A Theatre of Machines. London, 1964.
KEUTGEN, F. (1). *Urkunden zur städtischen Verfassungsgeschichte.* Berlin, 1901.
KIMAKOWICZ-WINNICKI, M. v. (1). *Spinn- und Webewerkzeuge. Entwicklung und Anwendung in vorgeschichtlicher ^eit Europas.* Würzburg, 1910. (Darstellungen über früh- und vorgeschichtliche Kultur- Kunst- und Völkerentwicklung, 2.)
KIRBY, R. H. (1). *Vegetable Fibres.* London, 1963.
KLEBS, L. (I). *Die Reliefs und Materialien des mittleren Reiches.* Heidelberg, 1922.
KLUGE, I. L. (ed.) (1). *Ostasiatische Studien. Martin Ramming zum yo. Geburtstag gewidmet.* Akademie-Verlag, Berlin, 1959.

KNECHTGES, DAVID R. (tr.) (1). ***Wen xuan or Selections of Refined Literature,*** **Vol. 1 :** ***Rhapsodies on Metropolises*** *and Capitals, Xiao Tong (301-531).* Princeton University Press, Princeton, 1982.

KOCH, P. A. & SATLOW, G. (eds.) (1). ***Großes Textil-Lexikon. Fachlexikon für das gesamte Textilwesen.*** **Deutsche** Verlagsanstalt, Stuttgart, 1965.

KOCH-GRÜNBERG, THEODOR (I). *Vom Raraima zum Orinoco.* Stuttgart, 1923, vol. 3.

Köm, MOGENS (1). ***Tojfra Tngre Bronzealder fremstillet afnaalda {Urtica dioica*** **L.). Arboger, 1943.**

KRÄMER, AUGUSTIN (I). 'Anfange und Unterschiede des Flechtens und Webens und Besprechung einiger alter Webstühle.' *ZE,* 1929, 49, 362-77.

KRAUSE, AUREL (I). *Die Tlinkit-Indianer.* Jena, 1885.

KUBY, THOMAS (I). 'Über den gesellschaftlichen Ursprung der Maschine.' *Technologie und Politik. Das* ***Magazin zur Wachstumskrise,*** **Juni 1980, 16, 71-101.**

KUHN, DIETER (I). ***Die Darstellung des Handwebstuhls in China. Eine Untersuchung zum Webstuhl in der chinesischen landwirtschaftlichen Literatur vor dem ig. Jahrhundert.*** **Köln, 1975.**

KUHN, DIETER (2). 'Die Darstellungen des Keng-chih-t'u und ihre Wiedergabe in populär-enzyklopädischen Werken der Ming-Zeit.' *Z^MG,* 1976, 2, **126;** 336-67.

KUHN, DIETER (3). ***Die Webstühle des Tzu-jen i-chih aus der Tüan-Zeit.*** **Franz Steiner, Wiesbaden, 1977.** (Sinologica Coloniensia, 5.)

KUHN, DIETER (4). 'Marginalie zu einigen Illustrationen im Nung-shu des Wang Chen.' In Goepper, R., **Kuhn, D. & Wiesner, U. (eds.) (1).** ***Z[ur] Kunstgeschichte Asiens. 50 Jahre Lehre und Forschung an der*** *Universität Köln.* Steiner Verlag, Wiesbaden, 1977. (Publikationen der Abteilung Asien. Kunsthistorisches Institut der Universität Köln, 1), 143-52.

KUHN, DIETER (5). 'Some Notes Concerning the Textile Technology Pictured in the Keng-chih-t'u.' *ZDMG,* 1980, 2, **130,** 408-16.

KUHN, DIETER (6). 'The Spindle-wheel: A Chou Chinese Invention.' *EC,* 1979-80, 5, 14-24.

KUHN, DIETER (7). 'Silk Technology in the Sung Period (960-1278 A.D.).' *TP,* 1981, 1-2, 67, 48-90.

KUHN, DIETER (8). 'The Silk-workshops of the Shang Dynasty (i6th-nth Century B.C.).' In Li Guohao, **Zhang Mengwen & Cao Tianqin (eds.) (1).** ***Explorations in the History of Science and Technology in China. The Special Number of the ' Collections of Essays on Chinese Literature and History ', in Honour of the Eightieth Birthday of Dr Joseph Needham, F.R.S., F.B.A.*** **Ku-Chi, Shanghai, 1982, 367-408.**

KUHN, DIETER (9). *Chinese Baskets and Mats.* Franz Steiner, Wiesbaden, 1980. (Publikationen der Abteilung Asien. Kunsthistorisches Institut der Universität Köln, 4.)

KUHN, DIETER (10). 'Short Report on My Visit to China (1979).' (Unpublished paper, in the 'Textile **Files' of the** ***East Asian History of Science Library of Joseph Needham,*** **Cambridge.)**

KUHN, DIETER (tr.) (n). *Itö Teiji, Alte Häuser in Japan.* Deutsche Verlagsanstalt, Stuttgart, 1983.

KUHN, DIETER (12). 'Tracing a Chinese Legend: In Search of the Identity of the First Sericulturalist.' *TP,* 1984,71. 213-245.

LA BAUME, WOLFGANG (I). 'Die vorgeschichtliche Handspindel und ihr Gebrauch.' *Mannus. Z[ntsc]hrißfür Vorgeschichte,* 8. Ergänzungsband, 1931, 71-3.

LA BAUME, WOLFGANG (2). 'Zwei verschiedene Arten des Spinnens mit der Handspindel.' *APVVV,* 1941, 1, 6, 2-4.

LA BAUME, WOLFGANG (3). *Die Entwicklung des Textilhandwerks in Alteuropa.* Bonn, 1955. (Antiquitas, 2.)

LACH, DONALD F. (5). *Asia in the Making of Europe.* Chicago, Toronto, 1965-77. (3 vols in 5 books.)

LAING, ELLEN J. (1). *Chinese Paintings in Chinese Publications,* ^056-/06¾. Ann Arbor, 1969. (Michigan Papers in Chinese Studies, 6.)

LANG, M. (I). ***Bestimmung des Onos oder Epinetron.*** **Berlin, 1908.**

LAUFER, BERTHOLD (3). *Chinese Pottery of the Han Dynasty.* Brill, Leiden, 1909.

LAUFER, BERTHOLD (21). 'The Discovery of a Lost Book.' *TP,* 1912, **13,** 97-106.

LAWTON, THOMAS (I). ***Freer Gallery of Art. Fiftieth Anniversary Exhibition. II. Chinese Figure Painting.*** **Washington,** D.C., 1973.

LE COQ,, ALBERT VON (I). *Chotscho.* Berlin, 1913.

LEADBEATER, ELIZA (2). *Spinning and Spinning Wheels.* Aylesbury, 1979. (Shire Album, 43.)

LEGGE, J. (tr.) (2). ***The Chinese Classics, etc. :*** **Vol. 1.** ***Confucian Analects, The Great Learning, and the Doctrine of*** *the Mean.* Legge, Hong Kong; Trübner, London, 1861. Photolitho re-issue, Hong Kong University Press, Hong Kong, i960, with supplementary volume of concordance tables, etc.

LEGGE, J. (tr.) (3). *The Chinese Classics, etc.:* Vol. 2. *The Works of Mencius.* Legge, Hong Kong; Trübner, London, 1861. Photolitho re-issue, Hong Kong University Press, Hong Kong, i960, with supplementary volume of concordance tables, and notes by A. Waley.

LEGGE, J. (tr.) (7). *The Texts of Confucianism,* Pt. III. *The Li Ki.* 2 vols. Oxford, 1885; reprint 1926.

LEGGE, J. (tr.) (8). ***The Chinese Classics, etc.:*** **Vol. 4, pts 1 and 2:** ***The She-King, with a Translation, Critical and Exegetical Notes, Prologomena, and Copious Indexes.*** **Lane Crawford, Hong Kong ; Trübner, London, 1871.** Repr., without notes, Com. Press, Shanghai, n.d. photolitho re-issue, Hong Kong University Press, Hong Kong, i960, with supplementary volume of concordance tables, etc.

LEGGE, J. (tr.) (io). *The Chinese Classics:* Vol. 3, pts. 1 and 2. *The Shoo King (Shu Ching).* Hong Kong, Trübner, London, 1865.

LEGGE, J. (tr.) (11). ***The Chinese Classics:*** **Vol. 5, pts. 1 and 2. 77K** ***Ch'un Ts'ew with the Tso Chuen (Chhun*** *Chhiu and Tso Chuan).* Hong Kong, 1872; Trübner, London, 1872.

LEMP, C.ARMIN & RIEGER, JONNY (I). *Die Seidenraupenzucht ein Frauenberuf.* Zürich, 1962. (Twelve facsimiles, in original size and colour, of Kitagawa Utamaro's prints illustrating the process of silk culture. From the collection of Theodor Scheiwe.)

LEROI-GOURHAN, A. (I). ***Évolution et Techniques;*** **Vol. I:** ***L'Homme et la Matière;*** **Vol. II:** ***Milieu et Techniques.*** Albin Michel, Paris, 1943, 1945.

LEWIN, GÜNTER (I). ***Die ersten fünf zig Jahre der Song-Dynastie in China. Beitrag zu einer Analyse der sozial-ökonomischen Formation während der ersten fünfzig Jahre der chinesischen Song-Dynastie {960-c. 1010).*** **Akademie-**Verlag, Berlin, 1973. (Veröffentlichungen des Museums für Völkerkunde zu Leipzig, 23.)

Li CMHIAO-PHING (ed.) (2). ***T'ien-kung k'ai-wu. Exploitation of the Work of Nature. Chinese Agriculture and Technology in the XVII Century by Sung Ying-hsing.*** **China Academy, Taipei, 1980. (Chinese Culture** Series, 2-3.)

Li CHI (6). *Anyang.* Dawson, Seattle, 1977.

LI GUOHAO, ZHANG MENGWEN & CAO TIANQTN (eds.) (1). ***Explorations in the History of Science and Technology in China. The Special Number of the ' Collections of Essays on Chinese Literature and History', in Honour of the Eighties Birthday of Dr Joseph Needham, F.R.S., F.B.A.*** **Ku-Chi, Shanghai, 1982.**

Li HUI-LIN (6). 'An Archaeological and Historical Account of Cannabis in China.' *EcB,* 1974, 4, a8, 437-8-

Li HUI-LIN (7). 'The Origin and Use of Cannabis in Eastern Asia. Linguistic-Cultural Implications.' *EcB,* 1974,4,88,293-301.

Li HUI-LIN (I I). ***Nan-fang ts'ao-mu chuang. A Fourth Century Flora of Southeast Asia.*** **Hong Kong University** Press, Hong Kong, 1979.

Li HUI-LIN (16). 'The Domestication of Plants in China: Ecogeographical Considerations.' In David N. Keightley (ed.) (4). *The Origins of Chinese Civilization.* Berkeley, 1983, 21-63.

Li, LILLIAN M. (1). ***China's Silk Trade. Traditional Industry in the Modem World 1842-1937.*** **Harvard University** Press, Cambridge, Mass., 1981. (Harvard East Asian Monographs, 97.)

LIEU, D. K. (I). *The Silk Industry of China.* Kelly & Walsh, Shanghai, 1941.

LINDER, ALFRED (I). *Spinnen und Weben einst und jetzt.* C. J. Bucher, Frankfurt am Main, Luzern, 1967.

LITHBERG, N. (I). ***Den korta herkuln eller handrocken.*** **Stockholm, 1930.**

Liu, JAMES T. C. (2). ***Reform in Sung China. Wang An-shih {1021-1086) and His New Policies.*** **Harvard Uni-versity** Press, Cambridge, Mass., 1959. (Harvard East Asian Studies, 3.)

LOESCH, H. VON (1). ***Die Kölner Zpnfturkunden, nebst anderen Kölner Gewerbeurkunden bis zum Jahre 1500.*** **Bonn,** 1907, vol. 2.

LOON, P. VAN DER (I). 'The Ancient Chinese Chronicles and the Growth of Historical Ideals.' In Beasley, W. G. & Pulleyblank, E. G. (eds.) (1). *Historians of China and Japan.* Oxford University Press, London, 1961, 24-30.

LOPEZ, R. S. (5). 'Silk Industry in the Byzantine Empire.' *S,* 1945, ao, 1-42.

LOPEZ, R. S. (6). 'China Silk in Europe in the Yuan Period.' *JAOS,* 1952, 2, 7a, 72-6.

LOPEZ, R. S. (7). ***The Commercial Revolution of the Middle Ages 950-1350.*** **Cambridge University Press,** Cambridge, 1971, 1976.

LOPEZ, R. S. (8). *The Birth of Europe.* H. Evans and Comp., New York, Aldine House, London, 1967; paperback 1972.

LOUD, GORDON (1). *Megiddo II. Seasons of 1935-1939.* Chicago, 1948. (The University of Chicago, Oriental Institute Publications, 62.)

LOWRY, JOHN (I). 'Han Textiles Excavated by Sir Aurel Stein and Others.' *OA,* i960, 6, 67-71.

LOWRY, JOHN (2). 'Early Chinese Silks.' *CR,* 1963, 2, 2-30.

LUBO-LESNICHENKO, E. I. (1). ***Drevnie kitaiskie shëlkovie vyshivki V do N.E.-III v. NE. v sobranii Gosudarst-vennogo Ermitazha.*** (Ancient Silk Textiles and Embroideries from the 5th Century B.c. to the 3rd Century A.D. in the Collections of the State Hermitage Museum). Leningrad, 1961.

LUNIAK, B. (1). *Ramie.* Zürich, 1949.

LYALL, L. A. (tr.) (2). *The Sayings of Confucius.* Longmans Green, London, 1935; (this edition superseded earlier editions).

MA TAI-LOI (I). 'The Authenticity of the Nan-fang ts'ao-mu chuang.' *TP,* 1978, 64, 218-52.

MAILEY, JEAN E. (I). 'Suggestions Concerning the Ground of the Ch'u Silk Manuscript in Relation to Silk Weaving in Pre-Han and Han China.' In Barnard, Noel (ed.) (2). *Early Chinese Art and Its Possible* ***Influence in the Pacific Basin.*** **Taipei, 1974, 103-22.**

MAILEY, JEAN E. & HATHAWAY, CALVIN S. (I). 'A Bonnet and a Pair of Mitts from Ch'ang-sha.' *CUC,* 1958, 10, a, 315-46-

MALLON, A., KOEPPEL, R. & NEUVILLE, R. (I). *Telailäl Ghassül.* I. *Compte Rendu des Fouilles de l'Institut Biblique Pontifical 1929-1932.* Rome, 1934. (Scripta Pontificii Instituti Biblici.)
MANNINEN, I. (1). *Die Finnisch-ugrischen Völker.* Harrassowitz, Leipzig, 1932.
MAO TUN (tr. by Sidney Shapiro) (1). *Spring Silkworms and Other Stories.* Foreign Languages Press, Peking, 1979.
MARKOWSKY, BARBARA (I). *Europäische Seidengewebe des 13.-18. Jahrhunderts.Bachem,* Köln, 1976. (Kataloge des Kunstgewerbemuseums Köln, 8.)
MARNEY, JOHN (tr.) (1). *Beyond the Mulberries. An Anthology of Palace-style Poetry by Emperor Chien-wen of the Liang Dynasty {503-551).* Chinese Materials Center, Taipei, :982.
MARSHALL, JOHN H. (ed.) (4). *Mohenjo-Daro and the Indus Civilisation.* London, 1931.
MASPERO, H. (I). 'La Composition et la Date du *Tso Chuan.' MCB,* 1931, 1, 137.
MAVERICK, L. A. (1). 'Hsii Kuang-ch'i, a Chinese Authority on Agriculture.' *AH,* 1940, 14, 143-60.
MAVERICK, L. A. (2). *Economic Dialogues in Ancient China: Selections from the Kuan-tzu.* Carbondale, 111., «954-
MCKNIGHT, BRIAN E. (tr.) (1). *The Washing away of Wrongs: Forensic Medicine in Thirteenth-century China.* Ann Arbor, 1981. (The University of Michigan Center for Chinese Studies, Science, Medicine, and Technology in East Asia, 1.)
MEDHURST, W. H. (1). *The Shoo King or Historical Classic.* Mission Press, Shanghai, 1846.
MEDLEY, MARGARET (3). *The Chinese Potter: A Practical History of Chinese Ceramics.* Phaidon Press, Oxford, 1976.
MEISSNER, KURT (I). 'Der alte japanische Handwebstuhl.' *Jubiläumsband zum 60-jährigen Bestehen der OAG.* Tokyo, 1933, part II, 60-81.
MELLAART, JAMES (2). 'Excavations at Catal Hüyük. First to Fourth Preliminary Reports.' *AS,* 1962, ia, 41-65; 1963, 13, 43-103; 1964, 14, 39-119; 1966, 16, 165-91.
MELLAART, JAMES (3). *The Neolithic of the Near East.* Thames & Hudson, London, 1975.
MELLENTHIN, F. (1). *Die Seilerei in Wort und Bild.* Berlin, 1930.
MENZIES, JAMES MELLON (2). *The Shang ko.* Royal Ontario Museum, Toronto, 1965.
MONIER-WILLIAMS, SIR MONIER (1). *A Sanskrit-English Dictionary. Etymologically and Philologically Arranged with Special Reference to Cognate Indo-European Languages.* New ed., Oxford, 1970.
MONTELL, GÖSTA (4). 'Spinning Tools and Spinning Methods in Asia' In Vivi Sylwan (3). *Woollen Textiles of the Lou-Ian People.* Stockholm, 1941, 109-27.
MOORE, F. (1). 'Description of a Species of Wild Mulberry Silkworm Allied to Bombyx, from Chekiang.' *North China Ann. & Mag. Natural History,* (June, 1885), 491-2.
MORGAN, E. (tr.) (1). *Too the Great Luminant; Essays from 'Huai Nan Tzu', with introductory articles, notes and analyses.* Kelly & Walsh, Shanghai, n.d. (1933?).
MORGAN, J. DE (I). *La préhistoire orientale.* Ouvrage posthume publié par Louis Germain, Paris, 1925-7.
MOULE, A. C. & YETTS, W. P. (1). *The Rulers of China, 221 to 1949;* Chronological Tables compiled by A. C. Moule, with an Introductory Section on the Earlier Rulers, *ca.* — 2100 to — 249 by W. P. Yetts. Routledge & Kegan Paul, London, 1957.
MÜLLER-KARPE, HERMANN (ed.) (1). *Beiträge zur allgemeinen und vergleichenden Archäologie.* Beck, München, 1983, Bd. 4: 1982.
MUMFORD, LEWIS (I). *Technics and Civilization.* Routledge, London, 1934.
MÜNKE, WOLFGANG (I). *Die klassische chinesische Mythologie.* Klett, Stuttgart, 1976.
NEEDHAM, JOSEPH. *Science and Civilisation in China.* Cambridge University Press, Cambridge, 1954-.
NETOLITZKY, ALMUT (I). *Das Ling-wai tai-ta von Chou Ch'ü-fei. Eine Landeskunde Sudchinas aus dem 11. Jahrhundert.* Franz Steiner, Wiesbaden, 1977. (Münchener Ostasiatische Studien, 21.)
NEUBURGER, ALBERT (I). *Die Technik des Altertums.* Voigtländer, Leipzig, 1919. (English edition: *The Technical Arts and Sciences of the Ancients.* Methuen, London, 1930.)
NEVERMANN, HANS (I). *Die indo-ozeanische Weberei.* Friederichsen, de Gruyter & Co., Hamburg, 1938. (Mitteilungen aus dem Museum für Völkerkunde in Hamburg, 20.)
NEWBERRY, PERCY E. (1). *Beni Hasan.* Archaeological Survey, London, 1843-1900.
NEWMAN, T. R. (I). *Contemporary Southeast Asia Arts and Crafts.* Crown Publishers, New York, 1977.
O'HARA, ALBERT (I). *The Position of Woman in Early China.* Taipei, 1969.
OHNEFALSCH-RICHTER, MAX (I). 'Neues über die auf Cypern mit Unterstützung Seiner Majestät des Kaisers, der Berliner Museen und der Rudolf-Virchow-Stiftung angestellten Ausgrabungen. XII. Die Spinnwirtel, Kunkeln und Schmuckperlen.' *VBGAEU,* 1899, 4, aa, 298-300.
ORTH, F. (1). 'Der Werdegang wichtiger Erfindungen auf dem Gebiete der Spinnerei und Weberei.' *BGTI,* 1922, xa, 61-8; 1927, 17, 88-94.
OZAWA TOSHIO (ed.) (1). *Japanische Märchen.* Frankfurt am Main, 1974. (Fischer Taschenbuch, 1469.)
PACHT, OTTO & THOSS, DAGMAR (I). *Französische Schule II. Reihe I: Die illuminierten Handschriften und Inkunabeln der österreichischen Nationalbibliothek.* Verlag der österreichischen Akademie der Wissen-

Schäften, Wien, 1977. (Veröffentlichungen der Kommission für Schrift- und Buchwesen des Mittelalters, ed. by Herbert Hunger.)
PARISET, E. (1). *Les industries de la soie.* Imprimerie Pitrat Aîné, Lyon, 1890.
PARISH, W. F. (1). 'Origin of Textiles and the Spinning Wheel.' *RTM,* 1936, **16,** 567-70.
PATTERSON, R. (I). 'Spinning and Weaving.' In Singer, Charles, Holmyard, E.J. & Hall, A. R. (eds.) (1). *History of Technology.* Oxford, vol. 2, 191-220.
PEDRETTI, C. (I). *Leonardo da Vinci: Fragments at Windsor Castle from the Codice Atlantico.* London, 1973.
PELLIOT, PAUL (24). ' A propos du Keng che t'ou.' *Mémoires concernant l'Asie orientale.* Publiées par l'Académie des Inscriptions et Belles-Lettres, Leroux, Paris, 1914, vol. 1, 65-122.
PELLIOT, PAUL (47). *Notes on Marco Polo; Ouvrage Posthume.* Paris, 1959, vol. 1 ; Impr. Nat. Maissonneuve, Paris, 1963, vol. 2.
PERKINS, D. Jr. (1). 'Fauna of Catal Hüyük.' *Science,* 1969, **164,** 177-9.
PÉTRIE, W. M. FLINDERS (I). *Tools and Weapons.* Constable, London, 1917. (British School of Archaeology in Egypt and Egyptian Research Account 22nd Year, 1916.)
PÉTRIE, W. M. FLINDERS (6). *Prehistoric Egypt.* London, 1920. (British School of Archaeology in Egypt and Egyptian Research Account 23rd Year, 1917.)
PFISTER, R. (3). ' Traces de tissu sur un miroir en cuivre provenant d'une tombe proto-élamite de Sialk (Période IV).' In R. Ghirshman (1). *Fouilles de Sialk près de Kashan 1933, 1934,1937.* Paris, 1938, 1939. **Vol. 2, 201-2.**
PFIZMAIER, A. (13) (tr.). 'Die Geschichte des Reiches U' (Wu). *DWAWjPH,* 1857, 8, 123. (Tr. ch. 31 *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (14) (tr.). 'Die Geschichte des Hauses Thai Kung' (of Chhi). *SWAWjPH,* 1862, 40, 465. (Tr. ch. 32, *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (15) (tr.) 'Die Geschichte des Hauses Tscheu Kung' (Chou Kung). *SWAWjPH,* **1863,41,90.** (Tr. ch. 33, *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (16) (tr.). 'Die Geschichte des Hauses Schao-Kung u. Khang-Scho' (of Yen and Wei). *SWAWjPH,* 1863, 41, 435, 454. (Tr. chs. 34, 37 *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (17) (tr.). 'Die Geschichte des Fürstenlandes Tsin' (Chin). *SWAW/PH,* 1863, 43, 74. (Tr. ch. 39 *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (18) (tr.). 'Die Geschichte des Fürstenlandes Tsu' (Chhu). *SWAWjPH,* 1863, 44, 68. (Tr. ch. 40, *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (19) (tr.). 'Keu-Tsien, König von Yue, und dessen Haus' (Kou Chien of Yueh and Fan Li). *SWAWjPH,* 1863, 44, 197. (Tr. ch. 41 *Shih Chi;* cf. Chavannes (1), vol. 4.)
PFIZMAIER, A. (20) (tr.). 'Geschichte d. Hauses Tschao' (Chao). *DWAWjPH,* 1859, 9, 45. (Tr. ch. 43, *Shih Chi;* cf. Chavannes (1), vol. 5.)
PFIZMAIER, A. (21) (tr.). 'Das Leben des Feldherrn U-Khi' (Wu Chi). *SWAW/PH,* 1859, 30, 267. (Tr. ch. 65, *Shift Chi;* not in Chavannes (1).)
PFIZMAIER, A. (22) (tr.). 'Der Landesherr von Schang' (Shang Yang). *SWAW/PH,* 1858, 39, 98. (Tr. ch. 68, *Shih Chi;* not in Chavannes (1). cf. Duyvendak (3).)
PFIZMAIER, A. (23) (tr.). 'Das Rednergeschlecht Su' (Su Chhin). *SWAW/PH,* i860, 3a, 642. (Tr. ch. 69. *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (24) (tr.). 'Der Redner Tschang I und einige seiner Zeitgenossen' (Chang I and Chhu Li Tzu). *SWAW/PH,* i860, 33, 525, 566. (Tr. chs. 70, 71, *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (25) (tr.). 'Wei-Jen, Fürst von Jang.' *SWAW/PH,* 1859, 30, 155. (Tr. ch. 72. *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (26) (tr.). 'Zur Geschichte vom Entsatz von Han Tan', *SWAW/PH,* 1859, 31, 65, 87, 104, 120. (Tr. chs. 75, 76, 78, 83, *Shih Chi;* includes life of the Prince of Phing Yuan; not in Chavannes (1).)
PFIZMAIER, A. (27) (tr.). 'Das Leben des Prinzen Wu Ki [Wu Chi] von Wei.' *SWAW/PH,* 1858, a8, 171. (Tr. ch. 77. *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (28) (tr.). 'Das Leben des Redners Fan Hoei' (Fan Hui). *SWAW/PH,* 1859, 30, 227. (Tr. ch, 80 (in part), *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (29) (tr.). 'Die Feldherren des Reiches Tschao.' *SWAW/PH,* 1858, a8, 55, 65, 69. (Tr. chs. 80 (in part), 81, 82, *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (30) (tr.). 'Li Sse, Der Minister des ersten Kaisers' (Li Ssu). *SWAW/PH,* 1859, 31, 120, 311. (Tr. chs. 83, 87, *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (31) (tr.). 'Das Ende Mung Tiens' (Meng Thien). *SWAW/PH,* i860, 3a, 134. (Tr. ch. 88, *Shih Chi;* not in Chavannes (1).)
PFIZMAIER, A. (32) (tr.). 'Die Genossen des Königs Tschin Sching' (Chang Erh and *ChhcnYü).SWA W/PH,* i860, 3a, 333. (Tr. ch. 89, *Shih Chi,* ch. 32, *Chhien Han Shu;* not in Chavannes (1).)
PFIZMAIER, A. (33) (tr.). 'Die Nachkommen der Könige von Wei, Tsi [Chhi] und Han.' *SWAW/PH,* i860, 33, 529, 533, 542, 551, 562, 567. (Tr. chs. 90, 93, 94, 97, *Shi Chi,* ch. 33, *Chhien Han Shu;* not in Chavannes (1).)

PFIZMAIER, A. (34) (tr.). 'Die Feldherren Han Sin, Peng Yue, und King Pu' (Han Hsin, Pheng Yüeh and Ching Pu). *SWAWIPH,* i860, 34, 371, 411, 418. (Tr. chs. 90 (in part), 91, 92, *Shih Chi;* ch. 34, *Chhien Han Shu;* not in Chavannes (1).)

PFIZMAIER, A. (35) (tr.). 'Der Abfall des Königs Pi von U' (Wu). *SWAW/PH,* 1861, 36, «7. (Tr. ch. 106, *Shih Chi;* not in Chavannes (1).)

PFIZMAIER, A. (36) (tr.). 'Sse-ma Ki-Tschü, der Wahrsager von Tschang-ngan' (Ssu-ma Chi-Chu in the chapter on diviners, *Jih Che Lieh Chuan). SWAWjPH,* 1861, 37, 408. (Tr. ch. 127, *Shih Chi;* not in Chavannes (1).)

PFIZMAIER, A. (37) (tr.). 'Die Gewaltherrschaft Hiang YüV (Hsiang Yü). *SWAWjPH,* i860, 3a, 7. (Tr. ch. 31, *Chhien Han Shu.)*

PFIZMAIER, A. (38) (tr.). 'Die Anfänge des Aufstandes gegen das Herrscherhaus Thsin' (Chhin). *SWAWI PH,* i860, 3a, 273. (Tr. ch. 33, *Chhien Han Shu.)*

PFIZMAIER, A. (39) (tr.). 'Die Könige von Hoai Nan aus dem Hause Han' (Huai Nan Tzu). *SWAWjPH,* 1862, 39, 575. (Tr. ch. 44, *Chhien Han Shu.)*

PFIZMAIER, A. (40) (TR.). 'Das Erreigniss des Wurmfrasses der Beschwörer.' *SWAW/PH,* 1862, 39, 50, 55, 58, 65, 76, 8g. (Tr. chs. 45, 63, 66, 74, *Chhien Han Shu.)*

PFIZMAIER, A. (41) (tr.). 'Worte des Tadelsin dem Reiche der Han.' *SWA WjPH,* 1861,35,206. (Tr.ch.51, *Chhien Han Shu.)*

PFIZMAIER, A. (42) (tr.). 'Die Heerführer Li Kuang und Li Ling.' *SWAW/PH,* 1863, 44, 511. (Tr. ch. 54, *Chhien Han Shu.)*

PFIZMAIER, A. (43) (tr.). 'Die Geschichte einer Gesandtschaft bei den Hiung-Nu's' (Su Wu). *SWAWIPH,* 1863, 44, 581. (Tr. ch. 54 (second part), *Chhien Han Shu.)*

PFIZMAIER, A. (44) (tr.). 'Die Heerführer Wei Tsing und Ho Khiu-Ping' (Wei Chhing and Ho Chhü-Ping). *SWAW/PH,* 1864, 45, 139. (Tr. ch. 55, *Chhien Han Shu.)*

PFIZMAIER, A. (45) (tr.). 'Die Antworten Tung Tschung-Schü's [Tung Chung Shu] auf die Umfragen des Himmelssohnes.' *SWAW/PH,* 1862, 39, 345. (Tr. ch. 56, *Chhien Han Shu.)*

PFIZMAIER, A. (46) (tr.). 'Zwei Statthalter der Landschaft Kuei Ki.' *SWAW/PH,* 1861, 37, 304. (Tr. ch. 64A (in part), *Chhien Han Shu.)*

PFIZMAIER, A. (47), (tr.). 'Die Bevorzugten des Allhalters Hiao Wu' [Emperor Hsien Wu Ti]. *SWAW/PH,* 1861, 38, 213, 234. (Tr. ch. 64A (second part), *Chhien Han Shu.)*

PFIZMAIER, A. (48) (tr.). ' Die Würdenträger Tsiuen Pu-I, Su Kuang, Yü Ting-Kue, und deren Gesinnungs-genossen' (Chien Pu-I, Su Kuang, Yü Ting-Kuo). *SWAW/PH,* 1862, 40, 131. (Tr. ch. 71, *Chhien Han Shu.)*

PFIZMAIER, A. (49) (tr.). 'Tschin Thang, Fürst-Zertrümmerer von Hu' (Chhen Thang). *SWAW/PH,* 1862, 40, 396. (Tr. ch. 70 (in part), *Chhien Han Shu.)*

PFIZMAIER, A. (50) (tr.). 'Die Menschenabtheilung der wandernden Schirmgewaltigen' *(yü hsia;* Knights errant; soldiers of fortune). *SWAWjPH,* 1861, 37, 103. (Tr. ch. 92, *Chhien Han Shu.)*

PFIZMAIER, A. (51) (tr.). 'Die Eroberung der beiden Yue [Yüeh] und des Landes Tschao Sien [Chao-Hsien, Korea] durch Han.' *SWAW/PH,* 1864, 46, 481. (Tr. ch. 95, *Chhien Han Shu.)*

PFIZMAIER, A. (52) (tr.). 'Zur Geschichte d. Zwischenreiches von Han.' *SWAW/PH,* 1869, 6x, 275, 309. (Tr. chs. 41, 42, *Hau Han Shu.)*

PFIZMAIER, A. (53) (tr.). 'Die Aufstände Wei-Ngao's und Kungsun Scho's' (Wei Ao and Kungsun Shu). *SWAW/PH,* 1869, 6a, 159. (Tr. ch. 43, *Hau Han Shu.)*

PFIZMAIER, A. (54) (tr.). 'Aus der Geschichte d. Zeitraumes Yuen-Khang von Tsin' (+ 292/ + 299). *SWAW/PH,* 1876, 8a, 179, 205, 212, 223, 230, 232. (Tr. chs. 31 (in part), 40, 58, 60, 100, *Chin Shu.)*

PFIZMAIER, A. (55) (tr.). 'Aus der Geschichte des Hofes von Tsin.' *SWAW/PH,* 1876, 81, 545, 561, 568. (Tr. chs. 31 (in part), 53, 59, *Chin Shu.)*

PFIZMAIER, A. (56) (tr.). 'Über einige Wundermänner Chinas' (magicians and technicians such as Chhen Hsün, Tai Yang, Wang Chia, Shun-yu Chih, etc.). *SWAW/PH,* 1877, 85, 37. (Tr. ch. 95, *Chin Shu.)*

PFIZMAIER, A. (57) (tr.). 'Die Machthaber Hoan Wen und Hoan Hiuen' (Huan Wen and Huan Hsüan). *SWAW/PH,* 1877, 85, 603, 632. (Tr. chs. 98, 99, *Chin Shu.)*

PFIZMAIER, A. (61) (tr.). 'Darlegungen a. d. Gesch. d. Hauses Sui.' *SWAW/PH,* 1881, 97, 627, 649, 653, 658, 686, 702. (Tr. chs. 36, 40, 45, 48, 79, *Sui Shu.)*

PFIZMAIER, A. (62) (tr.). 'Lebensbeschreibungen von Heerführern und Würdenträgern des Hauses Sui.' *DWAW/PH,* 1882,33,281,301,320,351,369. (Tr. chs. 37, 38, 39, 40 (in part), 41 (in part), *Sui Shu.)*

PFIZMAIER, A. (63) (tr.). 'Fortsetzungen a. d. Gesch. d. Hauses Sui.' *SWAW/PH,* 1882, 101, 187, 201, 207, 230, 249. (Tr. chs. 41 (in part), 70, 73 (in part), 74, 85, *Sui Shu.)*

PFIZMAIER, A. (64) (tr.). 'Die fremdländischen Reiche zu den Zeiten d. Sui.' *SWAW/PH,* 1881, 97, 411, 418, 422, 429, 444, 477, 483. (Tr. chs. 64, 81, 82, 83, 84, *Sui Shu.)*

PFIZMAIER, A. (65) (tr.). 'Die Classe der Wahrhaftigen in China.' *SWAW/PH,* 1881, 98, 983, 1001, 1036. (Tr. chs. 71, 73, 77, *Sui Shu.)*

PFIZMAIER, A. (66) (tr.). 'Zur Geschichte d. Aufstände gegen das Haus Sui.' *SWAW/PH,* 1878, 88, 729, 743, 766, 799. (Tr. chs. i, 84, 85, 86, *Hsin Thang Shu.)*

PFIZMAIER, A. (67) (tr.). 'Seltsamkeiten aus den Zeiten d. Thang', I and II. I, *SWAWjPH,* 1879, 94, 7, 11, 19. II, *SWAWjPH,* 1881, 96, 293. (Tr. chs. 34-6, *{Wu Hsing Chih)* 88, 89, *Hsin Thang Shu.)*

PFIZMAIER, A. (68) (tr.). 'Darlegung der chinesischen Ämter.' *DWAW/PH,* 1879, 29, 141, 170, 213; 1880, 30, 305, 341. (Tr. chs. 46, 47, 48, 49A, *Hsin Thang Shu;* cf. des Rotours (1).)

PFIZMAIER, A. (69) (tr.). 'Die Sammelhäuser der Lehenkönige Chinas.' *SWAW/PH,* 1880, 95, 919. (Tr. eh. 49B, *Hsin Thang Shu;* cf. des Rotours (1).)

PFIZMAIER, A. (70) (tr.). 'Über einige chinesische Schriftwerke des siebenten und achten Jahrhunderts n. Chr.' *SWAW/PH,* 1879, 93, 127, 159. (Tr. chs. 57, 59 (in part: / *Wen Chih,* agric, astron., maths., war, *wu hsing), Hsin Thang Shu.)*

PFIZMAIER, A. (71) (tr.). 'Die philosophischen Werke China's in dem Zeitalter der Thang.' *SWAW/PH,* 1878, 89, 237. (Tr. eh. 59 (in part: / *Wen Chih,* philosophical sect., incl. Buddh.), *Hsin Thang Shu.)*

PFIZMAIER, A. (72) (tr.). 'Der Stand der chinesische Geschichtsschreibung in dem Zeitalter der Thang' (original has Sung as misprint). *D WA WP/H,* 1877, 27, 309, 383. (Tr. chs. 57 (in part), 58 (/ *Wen Chih,* history and classics Section), *Hsin Thang Shu.)*

PFIZMAIER, A. (73) (tr.). 'Zur Geschichte d. Gründung d. Hauses Thang.' *SWAW/PH,* 1878, 9«, 21,46, 71. (Tr. chs. 86 (in part), 87, 88 (in part) *Hsin Thang Shu.)*

PFIZMAIER, A. (74) (tr.). 'Nachrichten von Gelehrten China's.' (Scholars such as Khung Ying-Ta, Ou-yang Hsün, etc.), *SWAW/PH,* 1878, 91, 694, 734, 758. (Tr. chs. 198, 199, 200, *Hsin Thang Shu.)*

PFIZMAIER, A. (84) (tr.). 'Aus dem Traumleben der Chinesen.' *SWAW/PH,* 1870, 64, 69, 711, 722, 733. (Tr. chs. 397, 398, 399, 400, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (85) (tr.). 'Geschichtliches ü. einige Seelenzuständeu. Leidenschaften.' *SWAW/PH,* 1868,59, 248, 258, 271, 274, 289, 302, 315. (Tr. *Thai-Phing Tu Lan,* chs. 469 (Furcht), 483 (Zorn), 489 (Vergesslichkeit u. Irrtum), 491 (Beschämung), 493 (Verschwendung), 498 (Hochmut), 499 (Dummheit).)

PFIZMAIER, A. (86) (tr.). 'Reichtum und Armut in dem alten China.' *SWAW/PH,* 1868,58,61,69,84,104, 110. (Tr. chs. 471, 472, 484, 485, 486, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (87) (tr.). 'Die Taolehre v. den wahren Menschen u. d. Unsterblichen.' *SWAW/PH,* 1869, 63, 217, 235, 252, 268. (Tr. chs. 660, 661, 662, 663, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (88) (tr.). 'Die Lösung d. Leichnam und Schwerter, ein Beitrag zur Kenntnis d. Taoglaubens.' *SWAW/PH,* 1870, 64, 26, 45, 6o, 79. (Tr. chs. 664, 665, 666, 667, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (89) (tr.). 'Die Lebensverlängerungen d. Männer des Weges' *(Too Shih). SWAW/PH,* 1870, 65. 3 " . 334. 34[6]> 359- ([Tr]- chs. 668, 669, 670, 671, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (90) (tr.). 'Über einige Kleidertrachten d. chinesischen Altertums.' *SWAWjPH,* 1872, 7». 567. 578, 5[88]. 593. 605, 609, 616, 627, 636, 640. (Tr. chs. 690, 691, 692, 693, 694, 695, 715, 716, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (91) (tr.). 'Denkwürdigkeiten v. chinesischen Werzeugen und Geräthen.' *SWAW/PH,* 1872, 72, 247, 265, 272, 275, 295, 308, 313, 315. (Tr. chs. 701 (screens), 702 (fans), 703 (whisks, sceptres, censers, etc.), 707 (pillows), 711 (boxes and baskets), 713 (chests), 714 (combs and brushes), 717 (mirrors), *Thai-Phing Tii Lan.)*

PFIZMAIER, A. (92) (tr.). 'Kunstfertigkeiten u. Künste d. alten Chinesen.' *SWAW/PH,* 1871, 69, 147, 164, 178, 202, 208. (Tr. chs. 736, 737 (magic), 750, 751 (painting) and 752 (inventions and automata), *Thai-Phing Tu Lan.)* -

PFIZMAIER, A. (93) (tr.). ' Zur Geschichte d. Erfindung u. d. Gebrauches d. chinesischen Schriftgattungen. *SWAWjPH,* 1872, 70, 10, 28, 46. (Tr. chs. 747, 748, 749, *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (94) (tr.). 'Beiträge z. Geschichte d. Perlen.' *SWAWjPH,* 1867, 57, 617, 629. (Tr. *Thai-Phing TU Lan,* chs. 802 (in part), 803.)

PFIZMAIER, A. (95) (tr.). 'Beiträge z. Geschichte d. Edelsteine u. des Goldes.' *SWAWjPH,* 1867, 58, 181, 194, 211, 217, 218, 223, 237. (Tr. chs. 807 (coral), 808 (amber), 809 (gems), 810, 811 (gold), 813 (in part), *Thai-Phing TU Lan.)*

PFIZMAIER, (96) (tr.). 'Zur Geschichte der alten Metalle.' *SWAW/PH,* 1868, 60, 7, 26, 44, 50, 67. (Tr. chs. 802 (in part) (gems), 804, 805 (gems), 812 (Hg, Ag, yellow Ag, Pb, Sn), 813 (in part) (Cu, Fe, brass), *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (97) (tr.). 'Alte Nachrichten u. Denkwürdigkeiten von einigen Lebensmitteln Chinas.' *SWAWjPH,* 1871, 67, 413, 418, 432, 441, 453, 459. (Tr. *Thai-Phing TU Lan,* chs. 857 (honey), 860 (cakes), 861 (soups), 863 (meat dishes), 865 (salt), 867 (tea).)

PFIZMAIER, A. (98) (tr.). 'Die Anwendung u. d. Zufälligkeiten des Feuers in d. alten China.' *SWAWjPH* '^79. *5> 767, 777, 786, 799. (Tr. chs. 868, 869 (fire and fire-wells), 870 (lamps, candles and torches), 871 (coal), of *Thai-Phing Tu Lan.)*

PFIZMAIER, A. (99) (tr.). 'Der Geisterglaube in dem alten China.' *SWAWjPH,* 1871, 68, 641, 652, 665, [6]79. 695- (Tr. *Thai-Phing Tu Un,* chs. 881, 882, 883, 884, 887 (in part).)

PFIZMAIER, A. (IOO) (tr.). 'Zur Geschichte d. Wunder in dem alten China.' *SWAWjPH,* 1871, 68, 809, 828, 844, 848. (Tr. *Thai-Phing Yü Lan,* chs. 885, 886, 887 (in part), 888 (quasi-biological metamorphoses).)

PFIZMAIER, A. (101) (tr.). 'Denkwürdigkeiten aus dem Tierreich Chinas.' *SWAWjPH,* 1875, 80, 6, 8, 17, 22, 35. 4«. 5'. 57. 68, 73, 79. (Tr. *Thai-Phing Yü Lan,* chs. 901, 902,903, 904, 905, 909,912 (mammals), 918, 919 (birds), 950 (in part), 951 (insects).)

PFIZMAIER, A. (102) (tr.). 'Über einige Gegenstände des Taoglaubens.' *SWAW/PH,* 1875, 79, 5, 16, 29, 4^2> 5°. 59. 61, 68, 73, 78. (Tr. *Thai-Phing Yü Lan,* chs. 929, 930 (dragons), 931, 932 (tortoises), 933, 934 (snakes), 984, 985, 986, 990 (miscellaneous stones).)

PFIZMAIER, A. (103) (tr.). 'Denkwürdigkeiten von den Insekten Chinas.' *SWAW\PH,* 1874, 78, 345, 356, 368, 378, 387, 397, 410. (Tr. *Thai-Phing Tu Lan,* chs. 944, 945, 946, 947, 948, 949, 950 (in part).)

PFIZMAIER, A. (104) (tr.). 'Denkwürdigkeiten von den Bäumen Chinas.' *SWAW/PH,* 1875,80, 191, 198, 205, 213, 220, 234, 240, 251, 264. (Tr. *Thai-Phing Tu Lan,* chs. 952, 953, 954, 955, 956, 957, 958, 959, 960 (in part).)

PFIZMAIER, A. (105) (tr.). 'Ergänzungen zu d. Abhandlung von den Bäumen Chinas.' *SWAW/PH,* 1875, 81, 143, 160, 167, 177, 188, 189, 192, 196. (Tr. *Thai-Phing TU Lan,* chs. 960 (in part), 961, 962, 963, 969 (in part), 972 (in part), 973 (in part), 974 (in part).)

PFIZMAIER, A. (106) (tr.). 'Denkwürdigkeiten v. den Früchten Chinas.' *SWAWjPH,* 1874, 7'. »95. 202, 214, 222, 230, 238, 249, 260, 267, 274, 280. (Tr. *Thai-Phing TU Lan,* chs. 964, 965, 966, 967, 968, 969 (in part), 970, 971, 972 (in part), 973 (in part), 974 (in part), 975.)

PHILLIPS, L. L. (I). *Cotton.* In N. W. Simmonds (ed.) (1). *Evolution of Crop Plants.* Longman, London, New York, 1976, 197-200.

PiGORiNi, L. (1). 'Zucht der Seidenspinner.' In R.O.Herzog & F. Oberlies (eds.) (1). *Technologie der Textilfasem.* Berlin, 1938, vol. 6:1: 'Die Seidenspinner,' 146-66.

PiUMATi, G. (ed.) (1). // *Codice Atlantico di Leonardo da Vinci,* JV. *Bibl. Ambrosiana (Milano).* Milano, 1894-1904, 4 vols.

PLONKA, F. (I). 'Domesticated Flax.' *CR,* 1965, a, 3-9.

PONTINO, KENNETH G. (ed.) (1). *Leonardo da Vinci. Drawings of Textile Machines.* Moonraker Press, Bradford-on-Avon, Humanities Press, New Jersey, 1979.

POSTAN, M. & RICH, E. E. (eds.) (1). *Cambridge Economic History of Europe.* Cambridge University Press, Cambridge, 1952, vol. 2.

POUNDS, N.J. G. (1). *An Economic History of Medieval Europe.* Longman Paperback, New York, 1974.

POWER, EILEEN (I). *Medieval Women* (ed. by M. M. Postan). Cambridge University Press, Cambridge, '975; repr. 1981.

PRUNNER, GERNOT (I). *Papiergötter aus China.* Hamburg, 1973. (Hamburgisches Museum für Völkerkunde: Wegweiser zur Völkerkunde, 14.)

PULLEYBLANK, E. G. (7). 'Chinese Historical Criticism; Liu Chih-chi and Ssu-ma Kuang.' In W. G. Beasley & E. G. Pulleyblank (1). *Historians of China and Japan.* Oxford University Press, London, 1961, 135.

RASOHKE, MANFRED G. (I). 'New Studies in Roman Commerce with the East.' In Hildegard Temporini (ed.) (1). *Aufstieg und Niedergang der Römischen Welt. Geschichte und Kultur Roms im Spiegel der Neueren Forschung.* De Gruyter, Berlin, 1978, vol. 9: 2, 604-1361.

RAU, WILHELM (1). *Weben und Flechten im Vedischen Indien.* Mainz, 1970. (Akademie der Wissenschaften und der Literatur. Abhandlungen der Geistes- und Sozialwissenschaftlichen Klasse, 11.)

READ, BERNARD E. (I) (with Liu JU-CHHIANG). *Chinese Medicinal Plants from the 'Pen Ts'ao Kang Mu' A.D. 1596.. .a Botanical, Chemical and Pharmacological Reference List.* (Publication of the Peking Nat. Hist. Bull.). French Bookstore, Peking, 1936 (chs. 12-37 *of Pen Tshao Kang Mu)* (rev. W. T. Swingle, *ARLCIDO,* 1937, 191).

READ, BERNARD E. (2) (with Li YÜ-THIEN). *Chinese Materia Medica; Animal Drugs.*

		Serial nos.	Corresp. with chaps, *of Pen Tshao Kang Mu*
Pt. I	Domestic Animals	322-349	50
II	Wild Animals	350-387	5^1 *A* and *B*
III	Rodentia	388-399	51 *B*
IV	Monkeys and Supernatural Beings	400-407	51 *B*
V	Man as a Medicine	408-444	52

PNHB, 1931, 5 (no. 4), 37-80; 6 (no. 1), 1-102. (Sep. issued, French Bookstore, Peking, 1931.)

READ, BERNARD E. (3) (with Li YÜ-THIEN). *Chinese Materia Medica; Avian Drugs.* 245-321 47, 48, 49
Pt. VI Birds

PNHB, 1932, 6 (no. 4), 1-101. (Sep. issued, French Bookstore, Peking, 1932.)

READ, BERNARD E. (4) (with Li YÜ-THIEN). *Chinese Materia Medica; Dragon and Snake Drugs.*

Pt. VII Reptiles	102-127	43

PNHB, 1934, 8 (no. 4), 297-357. (Sep. issued, French Bookstore, Peking, 1934.)

READ, BERNARD E. (5) (with Yu CHING-MEI). *Chinese Materia Medica; Turtle and Shellfish Drugs.*

Pt. VIII Reptiles and Invertebrates	199-244	45, 46

PNHB (Suppl.), 1939, 1-136. (Sep. issued, French Bookstore, Peking, 1937.)

READ, BERNARD E. (6) (with Yu CHING-MEI). *Chinese Materia Medica; Fish Drugs.*

Pt. IX Fishes (incl. some amphibia, octopoda and Crustacea)	128-198	44

PNHB (Suppl.), 1939. (Sep. issued, French Bookstore, Peking, n.d. prob. 193g.)

READ, BERNARD E. (7) (with Yu CHING-MEI). *Chinese Materia Medica; Insect Drugs.*

Pt. X Insects (incl. arachnidae etc.)	1-101	39, 40, 41, 42

PNHB (Suppl.), 1941. (Sep. issued, Lynn, Peking, 194«)-

READ, BERNARD E. (8). *Famine Foods listed in the 'Chiu Huang Pen Tshao'.* Lester Institute, Shanghai, 1946.

READ, BERNARD E. & PAK KYEBYÖNG (1). *A Compendium of Minerals and Stones used in Chinese Medicine, from the'Pen Tshao Kang Mu'. PNHB,* 1928,3 (no. 2),i-vii, 1-120. (Revised and enlarged, issued separately, French Bookstore, Peking, 1936 (2nd ed.).) Serial nos. 1-135, corresponding with chapters *of Pen Tshao Kang Mu* 8, 9, 10, 11.

REICHENBACH, E. (I). *Ueber Seidenraupenzucht und Cultur des Maulbeerbaumes in China, aus einer englischen Uebersetzung chinesischer Originalwerke ins Deutsche übertragen nebst einer Abhandlung über die Zusammensetzung der Maulbeerblätter und ihre Beziehung zur Seidenraupenkrankheit. Mit einem Vorwort von J. v. Liebig.* Cotta'sche Buchhandlung, München, 1867.

RETI, LADISLAO (ed.) (12). *The Madrid Codices of Leonardo da Vinci.* McGraw-Hill, New York, 1974 (vols. 1-11 plates, 111 commentary, iv-v transcriptions and translations), 5 vols.

RETI, LADISLAO (ed.) (13). *The Unknown Leonardo.* New York, 1974.

REYNOLDS, PHILIP K. & FANG, C. Y. (I). 'The Banana in Chinese Literature.' *HJAS,* 1940-1, 5, 165-8.

RiBouD, KRISHNA (I). 'Les soieries Han. Aspects nouveaux dans l'étude des soieries d'Asie centrale.' *AA,* 1967-8, 17,93-116.

RiBOUD, KRISHNA (2). 'A Closer View of Early Chinese Silks.' In Veronika Gervers (ed.) (1). *Studies in Textile History.* Toronto, 1977, 252-80.

RiBOUD, KRISHNA & VIAL, GABRIEL (I). *Tissus de Touen-houang conservés au Musée Guimet et à la Bibliothèque Nationale.* Paris, 1970. (Mission Paul Pelliot Documents Archéologiques, 13.)

TALBOT RICE, TAMARA (1). *Ancient Arts of Central China.* Thames & Hudson, London, 1965.

RIEK, GUSTAV (ed.) (1). *Der Hohmichele. Ein Fürstengrabhügel der Späten Hallstattzeit bei der Heuneburg. Heuneburgstudien 1.* Berlin, 1962. (Römisch-Germanische Kommission des Deutschen Archäologischen Instituts zu Frankfurt a. M. Römisch-Germanische Forschungen, 25.)

RITTER VOM TURN, DER (1). *Von den Exempelen der Gotsforcht und erberkeit by Michael Furtner.* Basel, 1493, (repr. Kurt ' Pfister, München, 1922).

RoNDOT, NATALIS (4). 'Notice sur le métier à tisser le jông et le ho.' *JA,* 1847, nlle sér. 9, 4, 332-50.

RONDOT, NATALIS (5). 'Manufacture of Grass-cloth.' *CRe,* 1849, 4, 18, 209-16.

RoNDOT, NATALIS (6). *Les soies.* Paris, 1885-7.

RoNDOT, NATALIS (?) (7). 'Chinese Grass-cloth; a Series of Sketches, Illustrating the Culture of Hemp and the Manufacture of Grass-cloth, from the Seed to the State Fit for Use.' *CRe,* 1847, 16, 209-23.

ROOVER, FLORENCE EDLER DE (I). 'Lucchese Silks, the Manufacturing Process.' *CR,* 1950, 80, 2902-30.

ROSNY, L. DE (tr.) (1). *Chan-Hai-King; antique géographie chinoise.* Maisonneuve, Paris, 1891.

ROTH, H. LING (I). *Studies in Primitive Looms.* Bankgeld Museum Notes, 8—11, 1916-18; repr. Halifax, 1934.

ROTOURS, R. DES (I). *Traité des Fonctionnaires et Traité de l'Armée, traduits de la Nouvelle Histoires des Tang* (chs. 46-50). 2 vols. Brill, Leiden, 1948 (Bibl. de l'Inst. des Hautes Etudes Chinoises, vol. 6). Rev. P. Demiéville, *JA,* 1950, 1138, 395.)

ROTOURS, R. DES (tr.) (2). *Traité des Examens* (translation of chs. 44 and 45 of the *Hsin Thang Shu).* Leroux, Paris, 1932. (Bibl. de l'Inst. des Hautes Etudes Chinoises, no. 2.)

RYDER, M. L. (1). 'Report of Textiles from Catal Hüyük.' *AS,* 1965, 15, 175-6.

SAILEY, JAY (I). ***The Master Who Embraces Simplicity. A Study of the Philosopher Ko Hung, A.D. 283-343.*** San Francisco, 1978.

SANSOM, SIR GEORGE (I). *Japan. A Short Cultural History.* Barrie & Jenkins, London, 1931; 3rd rev. ed., Tokyo, 1975.

SARFERT, E. (I). *Kusae.* Hamburg, 1919, vol. 1.

SCHAEFER, G. (1). 'Hemp.' *CR,* 1945, 49, 1779-87.

SCHILLING, ERNST (1). ***Die Faserstoffe des Pflanzenreiches für Weberei, Spinnerei, Seilerei, Flechterei, Papierfabrikation, für Binde-, Bürsten- und Stopfmaterial, mit ihren Namen im Ursprungsland, Handel und Wissenschaß.*** S. Hirzel, Leipzig, 1924. (Friedrich Tobler (ed.). Bücherei der Faserforschung, Bd. 11.)

SCHLEGEL, G. (5). *Uranographie Chinoise.* Brill, Leyden, 1875.

ScHLiEMANN, HEINRICH (i). ***Troy and Its Remains. A Narrative of Researches and Discoveries Made on the Site of Ilium, and in the Trojan Plain, edited by Philip Smith, 1875.*** **New York, 1976.**

SCHLIEMANN, HEINRICH (2). ***Troja, Results of the Latest Researches and Discoveries on the Site of Homer's Troy, 1882.*** Leipzig, 1884; Engl, ed., New York, 1976.

SCHMIDT-GLINTZER, HELWIG (tr.) (1). ***Mo Ti. Solidarität und allgemeine Menschenliebe. Mo Ti. Gegen den Krieg.*** Diederichs, Düsseldorf, 1975. 2 vols.

SCHULENBURG, W. VON (I). 'Das Wollespinnen mit Spindel und Wirtel.' ££, 1897, 2, 39, 168-9.

SCHULTES, R. E. (2). 'Random Thoughts and Queries on the Botany of Cannabis.' In C. R. B.Joyce & S. H. Gurry (eds.) (1). *The Botany and Chemistry of Cannabis.* London, 1970, 11-38.

SCHURMANN, H. F. (tr.) (1). ***Economic Structure of the Yuan Dynasty. Translation ofChapters*** **03** ***and 94 of the Titan Shih.*** Harvard University Press, Cambridge, Mass., 1956. (Harvard-Yenching Institute Studies, 16.)

SCHWARZ, A. (i). 'Early Forms of the Reel.' *CR,* 1947, 59, 2130-3.

SCHWARZ, A. (2). 'Reel and Spinning Wheel.' *CR,* 1947, 59, 2134-40.

SCHWARZ, A. (3). 'Silk Reels and Silk Mills.' *CR,* 1947, 59, 2145-53.

SCHWARZ, A. (4). 'Twisting Reel and Spinning Mill.' *CR,* 1947, 59, 2158-61.

SCHWARZ, A. (5). 'The Increased Effect of the Spindle.' *CR,* 1947, 59, 2165.

SEILER-BALDINGER, ANNEMARIE (I). *Systematik der Textilen Techniken.* Basel, 1973. (Basler Beiträge zur Ethnologie, 14.)

SHENG, ANGELA YU-YUN (I). 'LO: Textile Technology and Socio-Economic Conditions in the Lower Yangtze River in the Sung (A.D. 960-1279).' (unpublished study: University of Pennsylvania, Philadelphia.)

SHIBA YOSHINOBU (I) (tr. by MARK ELVIN). *Commerce and Society in Sung China.* Ann Arbor, 1970. (Michigan Abstracts of Chinese and Japanese Works on Chinese History, 2.)

SHIH, HSIO-YEN (I). 'Textile Finds in the People's Republic of China.' In Veronika Gervers (ed.) (1). ***Studies in Textile History.*** **Toronto, 1977, 305-31.**

SILBERMANN, HENRI (I). ***Die Seide. Ihre Geschichte, Gewinnung und Verarbeitung.*** **H.A.Ludwig Degener,** Leipzig, 1897.

SIMMONDS, N. W. (ed.) (1). *Evolution of Crop Plants.* Longman, London, New York, 1976.

SIMMONS, JACK (I). 'Technology in History.' *HT,* 1978, 3, 1-12.

SINGER, CHARLES, HOLMYARD, E.J. & HALL, A. R. (eds.) (1). *A History of Technology.* Clarendon Press, Oxford, 1954-8.

SIRELIUS, U. T. (1). *Suomen kansanomaista kulttuuria.* Helsinki, 1919.

SIREN, OSVALD (10). *Chinese Painting, Leading Masters and Principles.* Ronald, New York; Lund Humphries, London, 1956-8; reissued, New York, 1973, 6 vols.

SKINNER, G. WILLIAM (ed.) (1). *The City in Late Imperial China.* Stanford University Press, Stanford, 1977.

SÖCKELAND (I). 'Spinnen mit Spindel und Wirtel.' *£E,* 1897, 2, ag, 95-6.

SPIEGELBERG, WILHELM (I). 'tSC£(S): WCf (B) Spinnen.' *OL,* 1924, 27, 10, 567-70.

STEIN, SIR AUREL (2). ***Innermost Asia. Detailed Report of Explorations in Central Asia, Kan-su and Eastern Traan.*** Oxford, 1928.

STEIN, SIR AUREL (3). ***On Ancient Central-Asian Tracks. Brief Narrative of Three Expeditions in Innermost Asia andNorth-Western China.*** MacMillan and Co., London, 1933.

STEIN AUREL (4). ***Serindia. Detailed Report of Explorations in Central Asia and Westernmost China.*** **Clarendon** Press, Oxford, 1921, 5 vols.

STEIN, M. AUREL (11). ***Ancient Khotan. Detailed Report of Archaeological Explorations in Chinese Turkestan Carried Out and Described Under the Orders of H.M. Indian Government.*** **Clarendon Press, Oxford, 1907,** 2 vols.

STOKAR, W. VON (1). ***Spinnen und Weben bei den Germanen. Eine vorgeschichtlich-naturwissenschaftliche Untersuchung.*** Leipzig, 1938. (Mannus Bücherei, 59.)

STRADANUS, JOHANNES (JAN VAN DER STRAET) (I). *Nova Reperta,* see above, E. Dibner (2). (24 engravings issued in the early 1580s.)

SUN (I). See SUN E-TU ZEN & SUN SHIOU-CHUAN (tr.) (1).

SUN E-TU ZEN (a). 'Sericulture and Silk Textile Production in Ch'ing China.' In W. E. Willmott (éd.) (i). *Economie Organization in Chinese Society.* Stanford, 1972, 79—108.

SUN E-TU ZEN (tr.) (3). *Shih Min-hsiung. The Silk Industry in Ch'ing China.* Ann Arbor, 1976. (Michigan Abstracts of Chinese and Japanese Works on Chinese History, 5.)

SUN E-TU ZEN & SUN SHIOU-CHUAN (tr.) (1). *T'ien-kung k'ai-wu by Sung Ting-hsing. Chinese Technology in the Seventeenth Century.* The Pennsylvania State University Press, University Park/London, 1966.

SUN E-TU ZEN, FRANCIS, JOHN DE (tr. & eds.) (1). *Chinese Social History. Translations of Selected Studies.* New York, 1956; sec. ed., 1972. (American Council of Learned Societies. Studies in Chinese and Related Civilizations, 7.)

SWANN, NANCY (tr.) (1). *Food and Money in Ancient China.* Princeton University Press, Princeton, 1950.

SWANN, NANCY (2). *Pan Chao: Foremost Woman Scholar of China.* New York, 1932.

SYLWAN, VIVI (I). 'Siden i Kina under Yin-dynastien.' *MMA,* 1935, 19-21.

SYLWAN, VIVI (2). 'Silk from the Yin Dynasty.' *BMFEA,* 1937, 9, 119-26.

SYLWAN, VIVI (3). *Woollen Textiles of the Lou-Ian People. The Sino-Swedish Expedition, Pub. no. 15, VII; Archaeology: 2.* Stockholm, 1941.

SYLWAN, VIVI (4). *Investigation of Silk from Edson-gol and Lop-nor. The Sino-Swedish Expedition, Pub. no. 32, VII; Archaeology: 6.* Stockholm, 1949.

TEGGART, F. Y. (1). *Rome and China.* University of California Press, Berkeley, 1939.

TEMPORINI, HILDEGARD (ed.) (1). *Aufstieg und Niedergang der Römischen Welt. Geschichte und Kultur Roms im Spiegel der Neueren Forschung.* De Gruyter, Berlin, 1978, vol. 9: 2.

TENG SSU-YU & BIGGERSTAFF, K. (I). *An Annotated Bibliography of Selected Chinese Reference Works.* Harvard-Yenching Institute, Peiping, 1936. (Yenching Journal of Chinese Studies, Monograph no. 12.)

TERRELL, E. E. (1). *A Checklist ofNames for 3000 Vascular Plants of Economic Importance, United States Department of Agriculture. (Agriculture Handbook Number 505.)* Agricultural Research Service, Washington D.C., May, 1977.

TESCIONE, GIOVANNI (I). *L'arte della seta a Napoli et la Colonia de S. Leucio.* Napoli, 1932-3.

THIEMANN, WILHELM (I). *China. Photographische Aufzeichnungen aus den Jahren 1929-1936.* Simon & Magiera, München, 1982.

THRUPP, SYLVIA L. 'Medieval Industry 1000-1500.' In Carlo M. Cipolla (ed.) (4). *The Fontana Economic History of Europe: The Middle Ages.* 6th impr., Glasgow, 1981, 221-73.

TIETZE, KLAUS-PETER (I). *Ssuch'uan vom 7. bis 10. Jahrhundert. Untersuchungen zur frühen Geschichte einer chinesischen Provinz.* Franz Steiner, Wiesbaden, 1980. (Münchener Ostasiatische Studien, 23.)

TISDALE, ALICE (I). 'The Enchantment of the Old River.' *GR,* igig, 7, 11 ff.

TOD, OSMA GALLINGER & BENSON, OSCAR H. (I). *Weaving with Reeds and Fibres.* Dover Publ., New York, London, 1948; repr. New York, 1975.

TREVER, CAMILLA (1). *Excavations in Northern Mongolia 1924-1925.* Leningrad, 1932.

TRUMPY, OSCAR (I). *Georg Christoph Martini. Viaggio in Toscana 1-/25-1745.* Modena, 1969. (Deputazione di storia Patria per le antiche provincie Modenesi, Biblioteca nuova série n. 13.)

TWITCHETT, DENIS (4). *Financial Administration under the T'ang Dynasty.* 2nd ed., Cambridge University Press, Cambridge, 1970.

TWITCHETT, DENIS (I I). 'Hsüan-tsung (Reign 712-756).' In Denis Twitchett and John K. Fairbank (eds.) (1). *The Cambridge History of China.* Cambridge University Press, Cambridge, 1979, vol. 3:1, 333-463.

TWITCHETT, DENIS (12). *Printing and Publishing in Medieval China.* New York, Frederic C. Beil, 1983. (Based on a talk given to the Wynkyn de Worde Society at Stationers' Hall, London, on 28 September 1977.)

TWITCHETT, DENIS & FAIRBANK, JOHN K. (eds.) (1). *The Cambridge History of China.* Cambridge University Press, Cambridge, 1979, vol. 3:1.

UNGNAD, ARTHUR (I). 'Der Name des Spinnwirteis im Akkadischen.' *OL,* 1920, 7/8, 33, 154 ff.

USHER, ABBOTT PAYSON (I). *A History of Mechanical Inventions.* McGraw-Hill, New York, 1929, 2nd rev. ed. Harvard University Press, Cambridge, Mass., 1954.

VAVILOV, N. I. (2). 'The Origin, Variation, Immunity and Breeding of Cultivated Plants.' Tr. K. Starr Chester, *Chronica Botanica,* 1-6 (Waltham, Mass., 1949-50).

VIAL, GABRIEL (I). 'Les soieries Han. II—Analyse technique sur un spécimen de Noin Oula.' *AA,* 1967-8, 17, 117-41.

VISHNU-MITTRE (1). 'The Beginnings of Agriculture: Palaeographic Evidence from India.' In j. Hutchinson (2). *Evolutionary Studies on World Crops.* Cambridge University Press, Cambridge, 1974, 3-33.

VOGT, EMIL (I). *Geflechte und Gewebe der Steinzeit.* Basel, 1937.

VOLLMER, JOHN (I). 'Textile Pseudomorphs on Chinese Bronzes.' In Patricia L. Fiske (ed.) (1). *Archaeological Textiles.* Washington D.C., 1974, 170-4.

VOLLMER, JOHN (2). 'Archaeological and Ethnological Considerations of the Foot-Braced Body-Tension Loom.' In Veronika Gervers (ed.) (1). *Studies in Textile History.* Toronto, 1977, 343-54.

WADA, HIROSHI (I). *Prokops Rätselwort Serinda und die Verpflanzung des Seidenbaus von China nach dem oströmischen Reich.* (Dr.phil. thesis, Köln, 1970).

WAGNER, WILHELM (1). *Die chinesische Landwirtschaß.* Parey, Berlin, 1926.
WALEY, A. (tr.) (1). *The Book of Songs.* Allen & Unwin, London, 1937.
WALEY, A. (tr.) (5). *The Analects of Confucius.* Allen & Unwin, London, 1938.
WALEY, ARTHUR (19). *An Introduction to the Study of Chinese Painting.* Benn, London, 1923; repr. 1958.
WANG LIANG-ZHOU (I). '4,000 Years of Chinese Money.' *China Reconstructs,* 1982, 11, 56-62.
WARE, J.-R. (1). 'The *Wei Shu* and the *Sui Shu* on Taoism.' *JAOS,* 1933, 53, 215. Corrections and emendations in *JAOS,* 1934, 54, 290. Emendations by H. Maspero, *JA,* 1935, aa6, 313.
WATSON, ANDREW M. (I). 'The Rise and Spread of Old World Cotton.' In Veronika Gervers (ed.) (1). *Studies in Textile History.* Toronto, 1977, 355-68.
WEBER-PARTENHEIMER, W. (I). 'Ropemaking, Then and Now.' *CR,* 1971, 1, 2-45.
WECHSLER, HOWARD J. (1). 'The Founding of the T'ang Dynasty: Kao-tsu (Reign 618-626).' In Denis Twitchett & John K. Fairbank (eds.) (1). *The Cambridge History of China.* Cambridge, 1979, vol. 3: 1, 150-87.
WERNER, E. T. C. (I). *A Dictionary of Chinese Mythology.* Shanghai, 1932; repr. Julian Press, New York, 1961.
WESCHER, H. (I). 'The French Cloth Trade and the Fairs of Champagne.' *CR,* 1948, 65, 2379-93.
WHITE, LYNN, Jr. (5). 'Tibet, India, and Malaya as Sources of Western Medieval Technology.' *American Historical Review,* i960, 65, 515-26 (repr. in Lynn White, Jr. (21). *Medieval Religion and Technology. Collected Essays.* Berkeley, London, 1978, 43-57.)
WHITE, LYNN, Jr. (13). 'The Medieval Roots of Modern Technology and Science.' In Katherine F. Drew & Floyd S. Lear (eds.) (1). *Perspectives in Medieval History.* Chicago, 1963, 19-34; (repr. in Lynn White, Jr. (21). *Medieval Religion and Technology, Collected Essays.* Berkeley, London, 1978, 75-91.)
WHITE, LYNN, Jr. (20). 'The Expansion of Technology 500-1500.' In Carlo M. Cipolla (ed.) (4). *The Fontana Economic History of Europe.* Vol. 1 : *The Middle Ages.* 6th impr., Glasgow, 1981, 143-74.
WHITE, LYNN, Jr. (21). *Medieval Religion and Technology, Collected Essays.* University of California Press, Berkeley, London, 1978.
WHITE, LYNN, Jr. (22). *Medieval Technology and Social Change.* Oxford, 1962.
WICKLER, WOLFGANG & SEIBT, UTA (1). *Alt-Ekuadorianische Spinnwirtel und ihre Bildmotive.* In H. Müller-Karpe (ed.) (1). *Beiträge zur allgemeinen und vergleichenden Archäologie.* Beck, München, 1983, Bd. 4, '982, 3I5-4I9-
WIEGER, L. (I). *Textes Historiques.* (Ch. and Fr.). Mission Press, Hsienhsien, 1929.
WIEGER, L. (2). *Textes Philosophiques.* (Ch. and Fr.). Mission Press, Hsienhsien, 1930.
WIESNER, J. (1). *Die Rohstoffe des Pflanzenreiches.* Leipzig, 1927.
WILBUR, C. M. (I). 'Slavery in China during the Former Han Dynasty.' *Field Museum of Natural History Publications, Anthropological Series,* 1943, 34, 1-490.
WILD, J. P. (1). *Textile Manufacture in the Northern Roman Provinces.* Cambridge University Press, Cambridge, «97°-
WILHELM, RICHARD (tr.) (1). *Frühling und Herbst des Lü Bu-We.* (The Lü Shih Chhun Chhiu.) Diederichs, Jena, 1928.
WILHELM, RICHARD (tr.) (6). *Li Gi, das Buch der Sitte des älteren und jüngeren Dai.* (i.e. both Li Chi and Ta Tai Li Chi.) Diederichs, Jena, 1930.
WILKINSON, SIR GARDNER (1). *The Manners and Customs of the Ancient Egyptians.* London, 1878.
WILL, CHRISTOPH (I). *Die Korbflechterei—Schönheit und Reichtum eines alten Handwerks. Material, Technik, Anwendung.* Callwey, München, 1978.
WILLETTS, WILLIAM (1). *Chinese Art.* Penguin Books, Harmondsworth, 1958, A358-9.
WILLIAMS, S. W. (I). *The Chinese Commercial Guide.* 5th ed., Shortrede & Co., Hong Kong, 1863.
WILLIAMSON, H. R. (I). *Wang An-shih Chinese Statesman and Educationalist of the Sung Dynasty.* Probsthain, London, 1935-7.
WiLLiMOT, S. G. (I). 'Ramie Fibre, Its Cultivation and Development.' *WC,* 1954, 6, 405-8.
WILLMOTT, W. E. (ed.) (1). *Economic Organization in Chinese Society.* Stanford University Press, Stanford, 1972.
WILSHUSEN, WILHELM (1). *Abreise von China* (ed. by Roschen, Axel & Heye, Thomas). Stroemfeld/Roter Stern, Frankfurt, Basel, 1980.
WiTTLiN, A. (1). 'The Development of Wool Weaving in Spain.' *CR,* 1939, 20, 701-5.
WRIGHT, ARTHUR F. (9). 'The Sui Dynasty (581-617).' In Denis Twitchett & John K. Fairbank (eds.) (1). *The Cambridge History of China.* Cambridge, 1979, vol. 3:1, 48-149.
WRIGHT, ARTHUR F. (10). 'The Cosmology of the Chinese City.' In G. William Skinner (ed.) (1). *The City in Late Imperial China.* Stanford, 1977, 33~73.
Wu CHHI-CHHANG (I). 'The Chinese Land System before the Ch'in Dynasty.' In E-tu Zen Sun & John de Francis (eds.) (1). *Chinese Social History. Translations of Selected Studies.* (1956, 2nd ed., 1972), 55-8.
Wu KHANG (1). *Les Trois Politiques du Tchoun Tsieou interprétées par Tong Tchong-Chou d'après les principes de l'e'cole de Kong-Tang.* Leroux, Paris, 1932.

Wu, K. **T. (i).** 'Illustrations in Sung Printing.' *QJLC,* 197j, 3, 28, 173-95.
YETTS, W. P. (I). 'Discoveries of the Koslöv Expedition.' *BM,* 1926, 277, 48, 168-85.
ZACH, E. VON (6). *Die Chinesische Anthologie; Übersetzungen aus dem 'Wen Hsüan'.* 2 vols. Ed. I.M.Fang. Harvard University Press, Cambridge. Mass., 1958. (Harvard-Yenching Studies, no. 18.)
ZONCA, ViTTORio (i). *Nuovo Teatro di Machine et Edifiai.* Pietro Bertelli, Padua, 1607.

GENERAL INDEX

by FRANCES BROWN

NOTES

(1) Articles (such as 'the', 'al-', etc.) occurring at the beginning of an entry, and prefixes (such as 'de', 'van', etc.) are ignored in the alphabetical sequences. Saints appear among all letters of the alphabet according to their proper names. Styles such as Mr, Dr, if occurring in book titles or phrases, are ignored ; if with proper names, printed following them.

(2) The various parts of hyphenated words are treated as separate words in the alphabetical sequence. It should be remembered that, in accordance with the conventions adopted, some Chinese proper names are written as separate syllables while others are written as one word.

(3) In the arrangement of Chinese words, Chh- and Hs- follow normal alphabetical sequence, and *u* is treated as equivalent to u.

(4) References to footnotes are not given except for certain special subjects with which the text does not deal. They are indicated by brackets containing the superscript letter of the footnote.

{5) Explanatory words in brackets indicating fields of work are added for Chinese scientific and technological persons (and occasionally for some of other cultures), but not for political or military figures (except kings and princes).

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TABLE OF CHINESE DYNASTIES

夏	Hsia kingdom (legendary?)		*c.* −2000 to *c.* −1520
商	Shang (Yin) kingdom		*c.* −1520 to *c.* −1030
周	Chou dynasty (Feudal Age)	Early Chou period	*c.* −1030 to −770
		Chhun Chhiu period 春秋	−770 to −463
		Warring States (Chan Kuo) period 戰國	−463 to −221
First Unification	秦	Chhin dynasty	−221 to −207
	漢 Han dynasty	Chhien Han (Earlier or Western)	−202 to +9
		Hsin interregnum	+9 to +23
		Hou Han (Later or Eastern)	+25 to +220
	三國	San Kuo (Three Kingdoms period)	+221 to +265
First Partition	蜀	Shu (Han)	+221 to +264
	魏	Wei	+220 to +265
	吳	Wu	+222 to +280
Second Unification	晉	Chin dynasty: Western	+265 to +317
		Eastern	+317 to +420
	劉宋	(Liu) Sung dynasty	+420 to +479
Second Partition		Northern and Southern Dynasties (Nan Pei chhao)	
	齊	Chhi dynasty	+479 to +502
	梁	Liang dynasty	+502 to +557
	陳	Chhen dynasty	+557 to +589
	魏	Northern (Thopa) Wei dynasty	+386 to +535
		Western (Thopa) Wei dynasty	+535 to +556
		Eastern (Thopa) Wei dynasty	+534 to +550
	北齊	Northern Chhi dynasty	+550 to +581
	北周	Northern Chou (Hsienpi) dynasty	+557 to +581
Third Unification	隋	Sui dynasty	+581 to +618
	唐	Thang dynasty	+618 to +906
Third Partition	五代	Wu Tai (Five Dynasty period) (Later Liang, Later Thang (Turkic), Later Chin (Turkic), Later Han (Turkic) and Later Chou)	+907 to +960
	遼	Liao (Chhitan Tartar) dynasty	+907 to +1124
		West Liao dynasty (Qarā-Khiṭāi)	+1124 to +1211
	西夏	Hsi Hsia (Tangut Tibetan) state	+986 to +1227
Fourth Unification	宋	Northern Sung dynasty	+960 to +1126
	宋	Southern Sung dynasty	+1127 to +1279
	金	Chin (Juchen Tartar) dynasty	+1115 to +1234
	元	Yuan (Mongol) dynasty	+1260 to +1368
	明	Ming dynasty	+1368 to +1644
	清	Chhing (Manchu) dynasty	+1644 to +1911
	民國	Republic	+1912

N.B. When no modifying term in brackets is given, the dynasty was purely Chinese. Where the overlapping of dynasties and independent states becomes particularly confused, the tables of Wieger (i) will be found useful. For such periods, especially the Second and Third Partitions, the best guide is Eberhard (9). During the Eastern Chin period there were no less than eighteen independent States (Hunnish, Tibetan, Hsienpi, Turkic, etc.) in the north. The term 'Liu chhao' (Six Dynasties) is often used by historians of literature. It refers to the south and covers the period from the beginning of the +3rd to the end of the +6th centuries, including (San Kuo) Wu, Chin, (Liu) Sung, Chhi, Liang and Chhen. For all details of reigns and rulers see Moule & Yetts (1).

ROMANISATION CONVERSION TABLES

BY ROBIN BRILLIANT

PINYIN/MODIFIED WADE-GILES

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
a	a	chou	chhou
ai	ai	chu	chhu
an	an	chuai	chhuai
ang	ang	chuan	chhuan
ao	ao	chuang	chhuang
ba	pa	chui	chhui
bai	pai	chun	chhun
ban	pan	chuo	chho
bang	pang	ci	tzhu
bao	pao	cong	tshung
bei	pei	cou	tshou
ben	pen	cu	tshu
beng	peng	cuan	tshuan
bi	pi	cui	tshui
bian	pien	cun	tshun
biao	piao	cuo	tsho
bie	pieh	da	ta
bin	pin	dai	tai
bing	ping	dan	tan
bo	po	dang	tang
bu	pu	dao	tao
ca	tsha	de	te
cai	tshai	dei	tei
can	tshan	den	ten
cang	tshang	deng	teng
cao	tshao	di	ti
ce	tshe	dian	tien
cen	tshen	diao	tiao
ceng	tsheng	die	dieh
cha	chha	ding	ting
chai	chhai	diu	tiu
chan	chhan	dong	tung
chang	chhang	dou	tou
chao	chhao	du	tu
che	chhe	duan	tuan
chen	chhen	dui	tui
cheng	chheng	dun	tun
chi	chhih	duo	to
chong	chhung	e	e, o

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
en	en	jia	chia
eng	eng	jian	chien
er	erh	jiang	chiang
fa	fa	jiao	chiao
fan	fan	jie	chieh
fang	fang	jin	chin
fei	fei	jing	ching
fen	fen	jiong	chiung
feng	feng	jiu	chiu
fo	fo	ju	chü
fou	fou	Juan	chüan
fu	fu	jue	chüeh, chio
ga	ka	jun	chün
gai	kai	ka	kha
gan	kan	kai	khai
gang	kang	kan	khan
gao	kao	kang	khang
ge	ko	kao	khao
gei	kei	ke	kho
gen	ken	kei	khei
geng	keng	ken	khen
gong	kung	keng	kheng
gou	kou	kong	khung
gu	ku	kou	khou
gua	kua	ku	khu
guai	kuai	kua	khua
guan	kuan	kuai	khuai
guang	kuang	kuan	khuan
gui	kuei	kuang	khuang
gun	kun	kui	khuei
guo	kuo	kun	khun
ha	ha	kuo	khuo
hai	hai	la	la
han	han	lai	lai
hang	hang	lan	lan
hao	hao	lang	lang
he	ho	lao	lao
hei	hei	le	le
hen	hen	lei	lei
heng	heng	leng	leng
hong	hung	li	1'
hou	hou	lia	lia
hu	hu	Han	lien
hua	hua	Hang	Hang
huai	huai	Hao	Hao
huan	huan	lie	lieh
huang	huang	lin	lin
hui	hui	ling	Hng
hun	hun	liu	Hu
huo	huo	lo	lo
ji	chi	long	lung

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
lou	lou	pa	pha
lu	lu	pai	phai
lü	lü	pan	phan
luan	luan	pang	phang
lue	lüeh	pao	phao
lun	lun	pei	phei
luo	lo	pen	phen
ma	ma	peng	pheng
mai	mai	pi	phi
man	man	pian	phien
mang	mang	piao	phiao
mao	mao	pie	phieh
mei	mei	pin	phin
men	men	ping	phing
meng	meng	po	pho
mi	mi	pou	phou
mian	mien	pu	phu
miao	miao	qi	chhi
mie	mieh	qia	chhia
min	min	qian	chhien
ming	ming	qiang	chhiang
miu	miu	qiao	chhiao
mo	mo	qie	chhieh
mou	mou	qin	chhin
mu	mu	qing	chhing
na	na	qiong	chhiung
nai	nai	qiu	chhiu
nan	nan	qu	chhii
nang	nang	quan	chhüan
nao	nao	que	chhiieh, chhio
nei	nei	qun	chhiin
nen	nen	ran	jan
neng	neng	rang	jang
ng	ng	rao	jao
ni	ni	re	je
nian	nien	ren	jen
niang	niang	reng	jeng
niao	niao	ri •	jih
nie	nieh	rong	jung
nin	nin	rou	jou
ning	ning	ru	ju
niu	niu	rua	jua
nong	nung	ruan	juan
nou	nou	rui	jui
nu	nu	run	jun
nü	nü	ruo	jo
nuan	nuan	sa	sa
nüe	nio	sai	sai
nuo	no	san	san
o	o, e	sang	sang
ou	ou	sao	sao

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
se	se	wan	wan
sen	sen	wang	wang
seng	seng	wei	wei
sha	sha	wen	wen
shai	shai	weng	ong
shan	shan	wo	wo
shang	shang	wu	wu
shao	shao	xi	hsi
she	she	xia	hsia
shei	shei	xian	hsien
shen	shen	xiang	hsiang
sheng	sheng, seng	xiao	hsiao
shi	shih	xie	hsieh
shou	shou	xin	hsin
shu	shu	xing	hsing
shua	shua	xiong	hsiung
shuai	shuai	xiu	hsiu
shuan	shuan	xu	hsü
shuang	shuang	xuan	hsiian
shui	shui	xue	hsiieh, hsio
shun	shun	xun	hsün
shuo	shuo	ya	ya
si	ssu	yan	yen
song	sung	yang	yang
sou	sou	yao	yao
su	su	ye	yeh
suan	suan	yi	i
sui	sui	yin	yin
sun	sun	ying	ying
suo	so	yo	yo
ta	tha	yong	yung
tai	thai	you	yu
tan	than	yu	yü
tang	thang	yuan	yuan
tao	thao	yue	yüeh, yo
te	the	yun	yün
teng	theng	za	tsa
ti	thi	zai	tsai
tian	thien	zan	tsan
tiao	thiao	zang	tsang
tie	thieh	zao	tsao
ting	thing	ze	tse
tong	thung	zei	tsei
tou	thou	zen	tsen
tu	thu	zeng	tseng
tuan	thuan	zha	cha
tui	thui	zhai	chai
tun	thun	zhan	chan
tuo	tho	zhang	chang
wa	wa	zhao	chao
wai	wai	zhe	che

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
zhei	chei	zhui	chui
zhen	chen	zhun	chun
zheng	cheng	zhuo	cho
zhi	chih	zi	tzu
zhong	chung	zong	tsung
zhou	chou	zou	tsou
zhu	chu	zu	tsu
zhua	chua	zuan	tsuan
zhuai	chuai	zui	tsui
zhuan	chuan	zun	tsun
zhuang	chuang	zuo	tso

MODIFIED WADE-GILES/PINYIN

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
a	a	chhio	que
ai	ai	chhiu	qiu
an	an	chhiung	qiong
ang	ang	chho	chuo
ao	ao	chhou	chou
cha	zha	chhu	chu
chai	chai	chhuai	chuai
chan	zhan	chhuan	chuan
chang	zhang	chhuang	chuang
chao	zhao	chhui	chui
che	zhe	chhun	chun
chei	zhei	chhung	chong
chen	zhen	chhü	qu
cheng	zheng	chhüan	quan
chha	cha	chhüeh	que
chhai	chai	chhün	qun
chhan	chan	chi	ji
chhang	chang	chia	jia
chhao	chao	chiang	jiang
chhe	che	chiao	jiao
chhen	chen	chieh	jie
chheng	cheng	chien	jian
chhi	qi	chih	zhi
chhia	qia	chin	jin
chhiang	qiang	ching	jing
chhiao	qiao	chio	jue
chhieh	qie	chiu	jiu
chhien	qian	chiung	jiong
chhih	chi	cho	zhuo
chhin	qin	chou	zhou
chhing	qing	chu	zhu

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
chua	zhua	huan	huan
chuai	zhuai	huang	huang
chuan	zhuan	hui	hui
chuang	zhuang	hun	hun
chui	zhui	hung	hong
chun	zhun	huo	huo
chung	zhong	i	yi
chii	ju	jan	ran
chiian	juan	jang	rang
chiieh	jue	jao	rao
chün	jun	je	re
e	e, o	jen	ren
en	en	jeng	reng
eng	eng	jih	ri
erh	er	jo	ruo
fa	fa	jou	rou
fan	fan	ju	ru
fang	fang	jua	rua
fei	fei	Juan	ruan
fen	fen	jui	rui
feng	feng	jun	run
fo	fo	jung	rong
fou	fou	ka	ga
fu	fu	kai	gai
ha	ha	kan	gan
hai	hai	kang	gang
han	han	kao	gao
hang	hang	kei	gei
hao	hao	ken	gen
hen	hen	keng	geng
heng	heng	kha	ka
ho	he	khai	kai
hou	hou	khan	kan
hsi	xi	khang	kang
hsia	xia	khao	kao
hsiang	xiang	khei	kei
hsiao	xiao	khen	ken
hsieh	xie	kheng	keng
hsien	xian	kho	ke
hsin	xin	khou	kou
hsing	xing	khu	ku
hsio	xue	khua	kua
hsiu	xiu	khuai	kuai
hsiung	xiong	khuan	kuan
hsü	xu	khuang	kuang
hsüan	xuan	khuei	kui
hsüeh	xue	khun	kun
hsün	xun	khung	kong
hu	hu	khuo	kuo
hua	hua	ko	ge
huai	huai	kou	gou

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
ku	gu	mu	mu
kua	gua	na	na
kuai	guai	nai	nai
kuan	guan	nan	nan
kuang	guang	nang	nang
kuei	gui	nao	nao
kun	gun	nei	nei
kung	gong	nen	nen
kuo	guo	neng	neng
la	la	ni	ni
lai	lai	niang	niang
lan	lan	niao	niao
lang	lang	nieh	nie
lao	lao	nien	nian
le	le	nin	nin
lei	lei	ning	ning
leng	leng	niu	nüe
li	li	niu	niu
lia	lia	no	nuo
Hang	Hang	nou	nou
liao	liao	nu	nu
lieh	lie	nuan	nuan
lien	lian	nung	nong
lin	lin	nü	nü
ling	ling	o	e, o
liu	liu	ong	weng
lo	luo, lo	ou	ou
lou	lou	pa	ba
lu	lu	pai	bai
luan	luan	pan	ban
lun	lun	pang	bang
lung	long	pao	bao
lü	lü	pei	bei
lüeh	lue	pen	ben
ma	ma	peng	beng
mai	mai	pha	pa
man	man	phai	pai
mang	mang	phan	pan
mao	mao	phang	pang
mei	mei	phao	pao
men	men	phei	pei
meng	meng	phen	pen
mi	mi	pheng	peng
miao	miao	phi	pi
mieh	mie	phiao	piao
mien	mian	phieh	pie
min	min	phien	pian
ming	ming	phin	pin
miu	miu	phing	ping
mo	mo	pho	po
mou	mou	phou	pou

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
phu	pu	ten	den
pi	bi	teng	deng
piao	biao	tha	ta
pieh	bie	thai	tai
pien	bian	than	tan
pin	bin	thang	tang
ping	bing	thao	tao
po	bo	the	te
pu	bu	theng	teng
sa	sa	thi	ti
sai	sai	thiao	tiao
san	san	thieh	tie
sang	sang	thien	tian
sao	sao	thing	ting
se	se	tho	tuo
sen	sen	thou	tou
seng	seng, sheng	thu	tu
sha	sha	thuan	tuan
shai	shai	thui	tui
shan	shan	thun	tun
shang	shang	thung	tong
shao	shao	ti	di
she	she	tiao	diao
shei	shei	tieh	die
shen	shen	tien	dian
sheng	sheng	ting	ding
shih	shi	tiu	diu
shou	shou	to	duo
shu	shu	tou	dou
shua	shua	tsa	za
shuai	shuai	tsai	zai
shuan	shuan	tsan	zan
shuang	shuang	tsang	zang
shui	shui	tsao	zao
shun	shun	tse	ze
shuo	shuo	tsei	zei
so	suo	tsen	zen
sou	sou	tseng	zeng
ssu	si	tsha	ca
su	su	tshai	cai
suan	suan	tshan	can
sui	sui	tshang	cang
sun	sun	tshao	cao
sung	song	tshe	ce
ta	da	tshen	cen
tai	dai	tsheng	ceng
tan	dan	tsho	cuo
tang	dang	tshou	cou
tao	dao	tshu	cu
te	de	tshuan	cuan
tei	dei	tshui	cui

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
tshun	cun	wang	wang
tshung	cong	wei	wei
tso	zuo	wen	wen
tsou	zou	wo	wo
tsu	zu	wu	wu
tsuan	zuan	ya	ya
tsui	zui	yang	yang
tsun	zun	yao	yao
tsung	zong	yeh	ye
tu	du	yen	yan
tuan	duan	yin	yin
tui	dui	ying	ying
tun	dun	yo	yue, yo
tung	dong	yu	you
tzhu	ci	yung	yong
tzu	zi	yü	yu
wa	wa	yuan	yuan
wai	wai	yüeh	yue
wan	wan	yün	yun